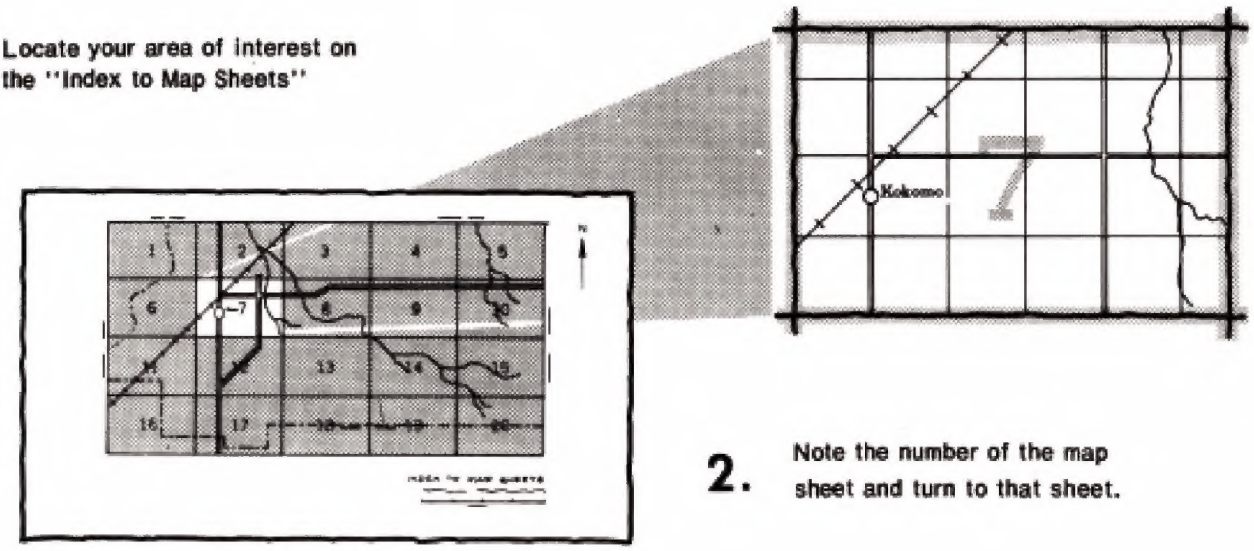
soil survey of

Weld County, Colorado
Southern Part

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Colorado Agricultural Experiment Station

HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"



2. Note the number of the map sheet and turn to that sheet.

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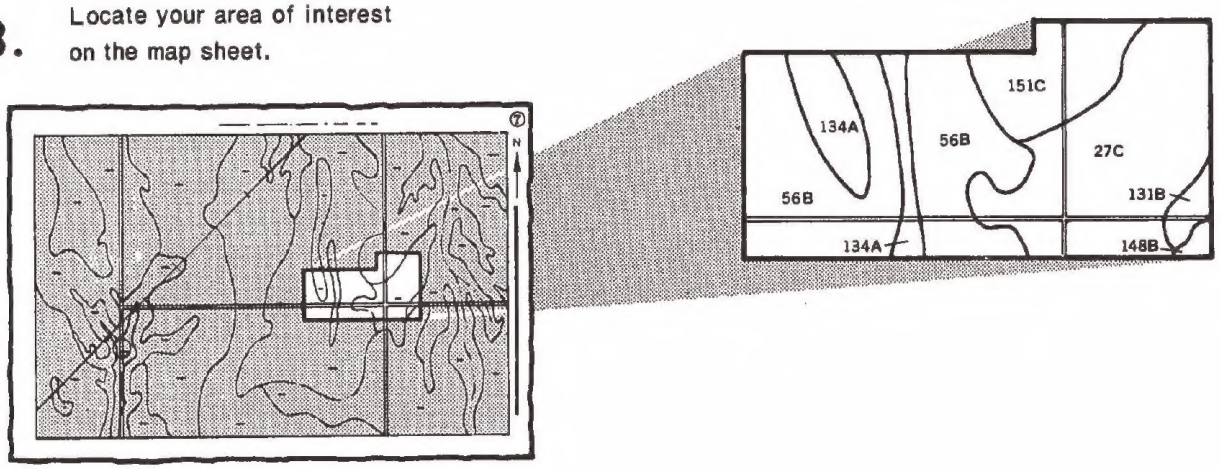

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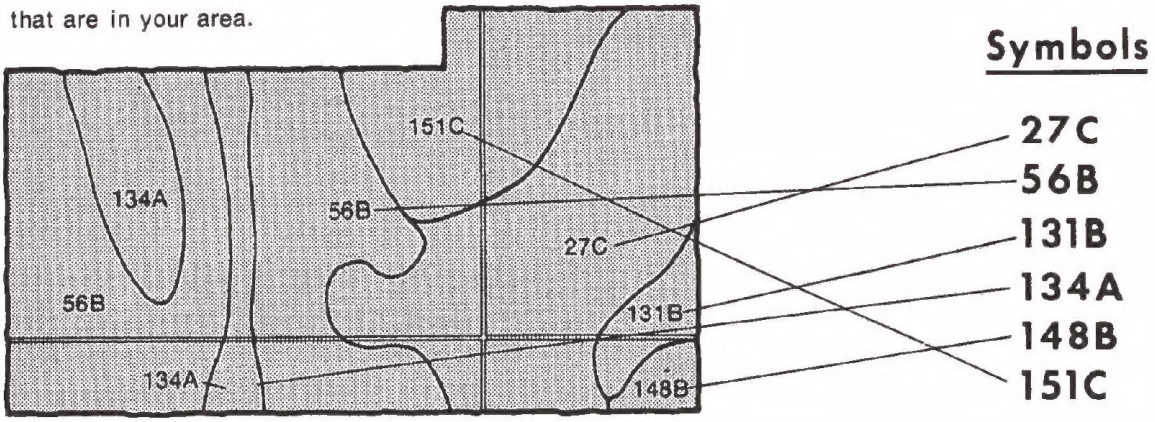
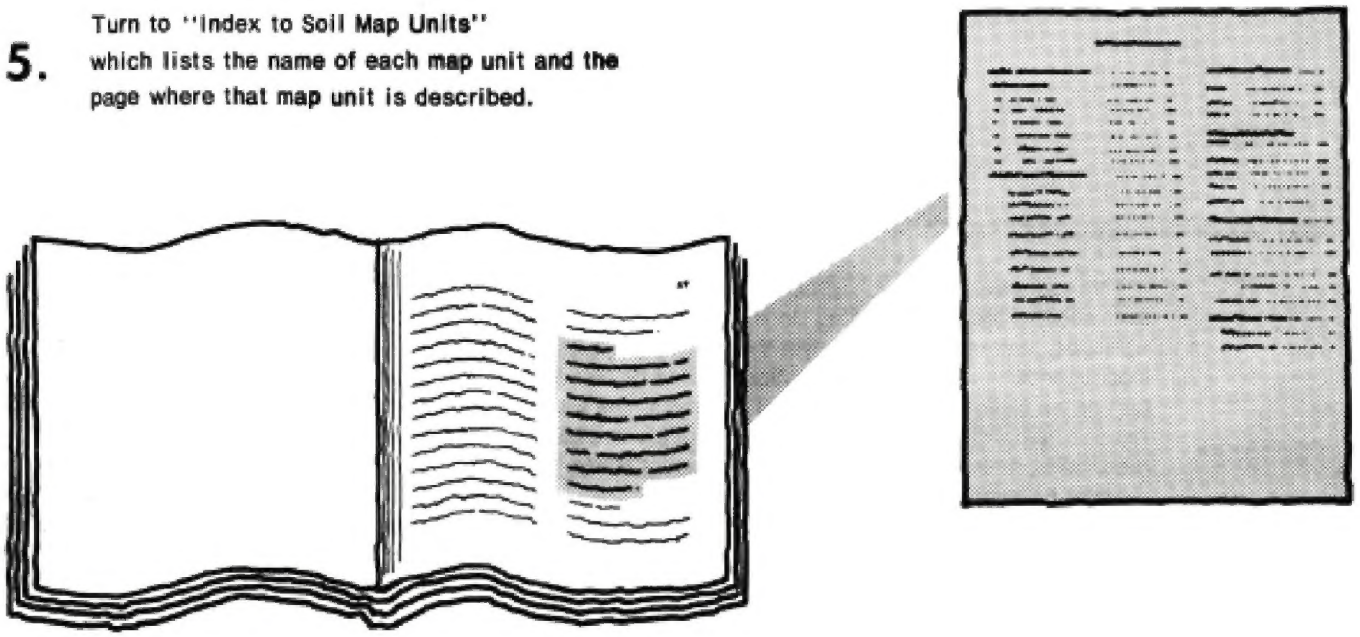
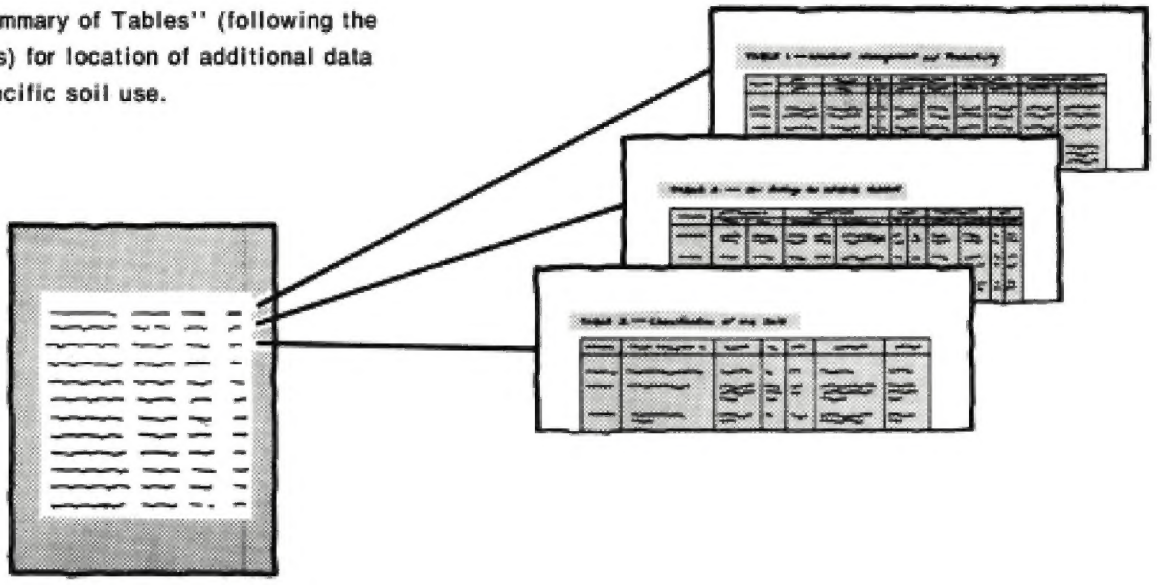


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1965-75. Soil names and descriptions were approved in April 1976. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the Big Thompson, Boulder Valley, Fort Collins, Longmont, Platte Valley, Southeast Weld, West Adams, and West Greeley Soil Conservation Districts.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: The three main agricultural products of the area. Sugar beets on Nunn soils, corn on Vona soils, and cattle on Kim soils.

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Foreword

The Soil Survey of Weld County, Colorado, Southern Part, contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

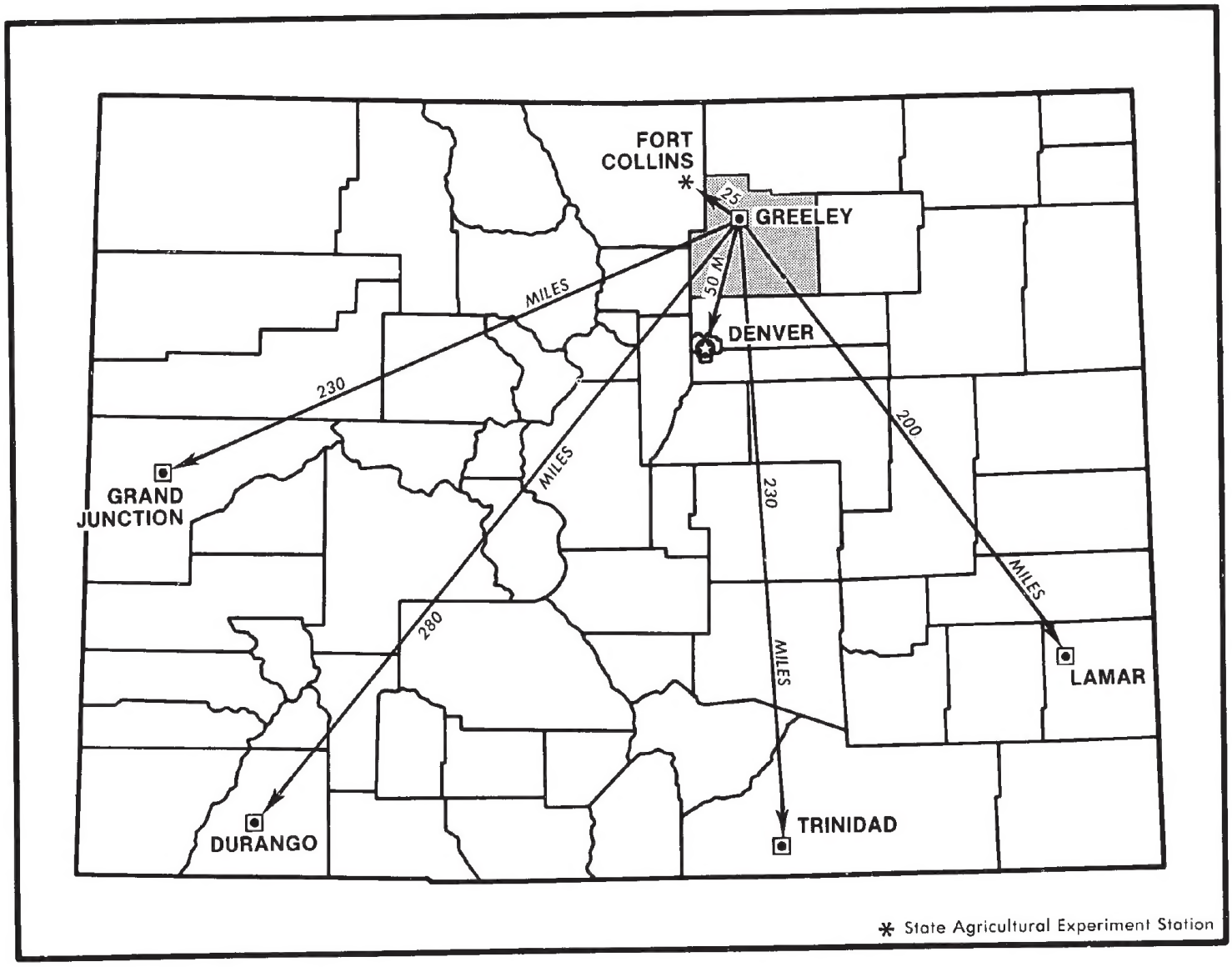
This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and homebuyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

M. D. Burdick
State Conservationist
Soil Conservation Service



Location of Weld County, Southern Part, in Colorado.

SOIL SURVEY OF WELD COUNTY, COLORADO, SOUTHERN PART

By James A. Crabb, Soil Conservation Service

Fieldwork by James A. Crabb, Thomas J. Wiggins, David Goeglein,
Donald C. Moreland and John J. Sampson, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service,
in cooperation with the Colorado Agricultural Experiment Station

WELD COUNTY, SOUTHERN PART, is in northeastern Colorado (see facing page). It has a total area of 1,152,000 acres, or 1,800 square miles. Greeley, the county seat, has a population of 54,100.

Southern Weld County lies entirely within the Colorado Piedmont section of the Great Plains physiographic province. The major feature is the South Platte River Valley, which extends across the southwestern and central parts. Topography is mainly broadly rolling. The major streams generally occupy wide valleys that are separated by broad, gently rolling to flat interstream divides. A large area of sandhills is in the eastern part of the survey area along both sides of the South Platte River Valley. Elevation ranges from about 5,250 feet in the northwest corner to about 4,400 feet at the eastern edge along the South Platte River.

General nature of the county

On the pages that follow is information on the climate, settlement of the county, natural resources, and farming.

Settlement of the county

It all started in 1492 when Columbus claimed the continent for Spain. In 1682 the French explorer Sieur de La Salle claimed the territory for France. In 1762 it was claimed again by Spain and in 1799, once again by France. In 1803 what is now the State of Colorado was part of the Louisiana Purchase.

Weld County was first a part of Louisiana, then Indiana, Missouri, Nebraska, Jefferson Territory, Colorado Territory, and finally the State of Colorado.

The area was first explored in 1806 by Zebulon Pike. In 1820 Major Stephen H. Long, on an expedition through the area, wrote, "In regard to this extensive section of country, I do not hesitate in giving the opinion that it is almost wholly unfit for cultivation, and of course, not inhabitable by a people depending upon agriculture for their subsistence."

Fort Lupton, the first permanent settlement in Weld County, was built in 1836 as a fort and trading post for trappers and hunters. Fort Saint Vrain, one of the many forts built by the American Fur Company during this period, was built in 1837. With the creation of the Colorado Territory in 1861, the County of St. Vrain, which was later to become Weld County, was established.

Fort Latham, about 3 miles northeast of Greeley on the old Cherokee Trail, was the county seat from 1864 to 1870. With the coming of the Denver-Pacific Railway between Cheyenne and Denver, the county seat was moved to Evans and later to Greeley.

Cattlemen were the earliest permanent settlers. The cattle herds slowly pushed the buffalo out, and with them the trappers and hide hunters.

In 1870, the Greeley Union Colony was founded with agriculture as its basis. The colonists dug the first irrigation ditches from the Cache La Poudre River. The Homestead Act and barbed wire fencing transformed the cattle industry from open range to ranches and farms. Slowly but surely the irrigated district expanded as new ditches were constructed. Today Weld County is the center of one of the largest irrigated areas in the world, and it ranks third in the United States in value of agricultural products produced.

Natural resources

The soils and topography of the survey area can be considered its most important natural resource. They sustain an extensive, well developed agricultural economy.

Irrigation water is abundant. The land is irrigated by a system of reservoirs and ditches supplied from the Cache la Poudre River, the Big Thompson River, the Little Thompson River, St. Vrain Creek, and the South Platte River. The supply from these sources is augmented by water brought from the western slope of the Rockies by the Colorado Big Thompson project. In addition to the surface water, the deep broad aquifers, which follow and are recharged by the rivers, have made the development of highly productive shallow wells possible. There are also

several areas in the higher plains where deep wells produce enough for irrigation.

The chief mineral resources are sand and gravel, coal, petroleum, and gas. These resources form a minor part of the economy at present, but they could have a strong economic impact in the future.

Farming

The total number of farms in the survey area has steadily decreased since 1930. The number of acres farmed reached its peak in 1950 and has since been decreasing each year as more urban and industrial growth competes for land. In 1973 about 43 percent of the land was irrigated cropland, 18 percent nonirrigated cropland, 37 percent rangeland, and 2 percent urban and industrial development and recreation areas (*3*). The total acreage in farm crops is steadily decreasing, but the total production and the market value of the crops continues to increase. Farmers are using more efficient management and general production practices, and research continues in farm machinery, plant breeding, soil and fertilizer science, and weed, insect and disease control.

The irrigated farmland of the area is capable of supporting a wide variety of crops. The main crops are corn, alfalfa, sugar beets, pinto beans, potatoes, and onions. Malting barley and vegetables are grown on limited acreages.

Most of the corn grown in the area, both silage and grain, is used for feed at commercial feedlots, (fig. 1), farm feedlots, and dairies. Sugar beets are processed at factories in Brighton, Greeley, Longmont, and Loveland. Several truck farms are in the southern part of the survey area, and there is a ready market for fresh vegetables in the Denver metropolitan area. Several varieties of vegetables are processed at canning factories nearby and there are facilities for procesing meat and dairy products locally in Greeley and in Denver. Significant numbers of sheep and turkeys use the feed crops of the area.

A small grain-summer fallow rotation is the main type of farming on the nonirrigated soils. Summer fallowing is necessary to store enough moisture for sustained high yields. Wheat is the principal crop, but barley and sorghum are also grown.

Climate

Weld County is usually warm in summer, and hot days are frequent. In winter, periods of very cold weather are caused by Arctic air moving in from the north or northwest. These cold periods alternate with frequent milder periods that occur when westerly winds are warmed as they move downslope. Most precipitation falls as rain during the warmer part of the year. Rain is normally heaviest late in spring and early in summer. Winter snowfall is frequent, but snow cover usually disappears during mild periods.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Greeley and Ft. Lupton for the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 29 degrees F, and the average daily minimum temperature is 14 degrees. The lowest temperature on record, which occurred at Greeley on February 1, 1951, is -39 degrees. In summer the average temperature is 70 degrees, and the average daily maximum temperature is 87 degrees. The highest recorded temperature, which occurred at Ft. Lupton on June 23, 1954, is 108 degrees.

Growing degree days, shown in table 1 , are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 9 inches, or 75 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 6.50 inches. The heaviest 1-day rainfall during the period of record was 3.20 inches at Greeley on June 8, 1974. Thunderstorms number about 41 each year, 29 of which occur in summer. Some years summer hailstorms cause severe local damage to crops.

Average seasonal snowfall is 40 inches. The greatest snow depth at any one time during the period of record was 30 inches. On the average, 18 days have at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year. Some years a heavy blizzard with high winds and drifting snow strikes the county, and snow remains on the ground for many weeks.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 69 percent. The percentage of possible sunshine is 71 in summer and 70 in winter. The prevailing wind is from the south. Average windspeed is highest, 10.4 miles per hour, in April.

Climate data in this section were specially prepared for the Soil Conservation Service by the National Climatic Center, Asheville, North Carolina.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They

dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show canals, buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland, engineers, planners, developers and builders, homebuyers, and those seeking recreation.

General soil map for broad land use planning

The general soil map at the back of this publication shows, in color, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

1. Midway-Shingle

Shallow, moderately sloping to strongly sloping, well drained clays and loams formed in residuum from calcareous shale

This moderately to strongly sloping map unit is in the southwestern part of the survey area. It is on the ridge crests and side slopes along Coal Creek and its drainageways. It makes up less than 1 percent of the total acreage. About 40 percent is Midway soils, 35 percent is Shingle soils, and 25 percent is soils of minor extent.

Midway and Shingle soils occupy similar positions on the landscape. Midway soils have a clay surface layer and underlying material. Shingle soils have a loam surface layer and clay loam underlying material. Both soils are underlain by calcareous shale at depths of 10 to 20 inches.

Minor in this unit are the well drained Renohill and Ulm soils. There are also small sandstone outcrops.

This map unit is used mainly for rangeland. Small areas have been cultivated. Shallowness is the main limitation in farming. The potential is fair for development of rangeland wildlife habitat.

2. Ulm-Nunn

Deep, level to gently sloping, well drained clay loams and loams formed in alluvial and eolian deposits

This level to gently sloping map unit is on plains and old terraces in the southwestern part of the survey area. It makes up about 1.5 percent of the total acreage. About 40 percent is Ulm soils, 35 percent is Nunn soils, and 25 percent is soils of minor extent.

Ulm soils occupy the higher, gently sloping areas, and Nunn soils the more nearly level areas or the swales. Ulm soils have a clay loam surface layer and a clay loam subsoil.

Minor in this unit are the well drained Renohill and Wiley soils and the moderately well drained Heldt soils.

This map unit is used mainly for irrigated and nonirrigated cropland. Some areas are still in rangeland. Slow permeability is the main limitation in farming. The poten-

tial for urban development is only fair to poor. The main limitations are moderate to high shrink swell, low strength, and slow permeability. The potential is fair for development of openland wildlife habitat.

3. Weld-Colby

Deep, nearly level to moderately sloping, well drained loams formed in calcareous eolian deposits

This nearly level to moderately sloping map unit is on plains mainly in the southeastern part of the survey area. One small area is in the west-central part. The unit makes up about 10 percent of the total acreage. About 50 percent is Weld soils, 35 percent is Colby soils, and 15 percent is soils of minor extent.

Weld soils occupy the broad nearly level areas. Colby soils occupy the steeper side slopes. Weld soils have a loam surface layer and a clay and clay loam subsoil. Colby soils have a loam surface layer and silt loam underlying material.

Minor in this unit are the well drained Adena and Kim soils.

This map unit is used mainly for cropland. About 65 percent is nonirrigated. Winter wheat is the principal crop. If irrigated, the soils are well suited to all commonly grown crops. The potential is fair for development of openland wildlife habitat.

4. Wiley-Colby-Weld

Deep, nearly level to moderately sloping, well drained silt loams and loams formed in calcareous eolian deposits

This nearly level to moderately sloping map unit is on plains in the west-central and southwestern parts of the survey area. It makes up about 5.5 percent of the total acreage. About 30 percent is Wiley soils, 30 percent is Colby soils, 15 percent is Weld soils, and 25 percent is soils of minor extent.

Wiley and Colby soils form an intermingled complex pattern on the steeper side slopes. Weld soils are along the narrow ridgetops and on the nearly level side slopes. Wiley soils have a silt loam surface layer and a silty clay loam subsoil. Colby soils have a loam surface layer and silt loam underlying material. Weld soils have a loam surface layer and a clay loam subsoil.

Minor in this unit are the moderately well drained Heldt soils and the well drained Nunn and Ulm soils.

This map unit is used mainly for cropland. About 70 percent is irrigated and is well suited to all commonly grown crops. In nonirrigated areas, winter wheat is the principal crop. The potential is fair for urban development. Moderately slow permeability is the main limitation. The potential is also fair for development of openland wildlife.

5. Olney-Kim-Otero

Deep, nearly level to moderately sloping, well drained sandy loams and loams formed in mixed alluvium and eolian deposits

This nearly level to moderately sloping map unit is on plains and alluvial fans throughout the survey area. It makes up about 23.5 percent of the total acreage. About 35 percent is Olney soils, 20 percent is Kim soils, 15 percent is Otero soils, and 30 percent is soils of minor extent.

The soils in this map unit occupy the same relative positions on the landscape (fig. 2). Olney soils have a loamy sand or sandy loam surface layer and a sandy clay loam subsoil. Kim soils have a loam surface layer and loam and fine sandy loam underlying material. Otero soils have a sandy loam surface layer and fine sandy loam underlying material.

Minor in this unit are the well drained Ascalon, Nelson, Thedalund, and Vona soils.

This map unit is used for irrigated and nonirrigated cropland and for rangeland. The potential is good for urban development and fair for wildlife habitat.

6. Otero-Thedalund-Nelson

Deep and moderately deep, nearly level to moderately sloping, well drained sandy loams and clay loams formed in alluvium and eolian deposits and in residuum from shale and sandstone

This nearly level to moderately sloping map unit is on plains in the north-central part of the survey area. It makes up about 3 percent of the total acreage. About 35 percent is Otero soils, 25 percent is Thedalund soils, 25 percent is Nelson soils, and 15 percent is soils of minor extent.

Otero soils are on the nearly level or smoother side slopes. Thedalund and Nelson soils are intermingled and are on the steeper side slopes. Otero soils have a sandy loam surface layer and fine sandy loam underlying material. Thedalund soils have a loam surface layer and underlying material. Shale is between depths of 20 and 40 inches. Nelson soils have a fine sandy loam surface layer and underlying material. Sandstone is between 20 and 40 inches.

Minor in this unit are the well drained Kim, Renohill, Terry, and Vona soils.

This map unit is used mainly for irrigated cropland. Soil depth is the main limitation in farming and urban development. The potential is fair for development of openland wildlife habitat.

7. Tassel-Thedalund-Terry

Shallow to moderately deep, gently sloping to strongly sloping, well drained sandy loams to clay loams formed in residuum from sandstone and shale

This gently sloping to strongly sloping map unit is in the western part of the survey area, adjacent to and including the sandstone breaks along some of the major streams. It makes up about 1 percent of the total acreage. About 50 percent is Tassel soils, 20 percent is Thedalund soils, 20 percent is Terry soils, and 10 percent is soils of minor extent.

Tassel soils are on the crests and shoulders of the ridges and breaks. Thedalund soils are below the breaks, and Terry soils are on the smoother side slopes above the breaks. Tassel soils have a fine sandy loam surface layer and very fine sandy loam underlying material. Sandstone is between 10 and 20 inches. Thedalund soils have a loam surface layer and underlying material. Shale is between 20 and 40 inches. Terry soils have a fine sandy loam surface layer and subsoil. Sandstone is between 20 and 40 inches.

Minor in this unit are the well drained Nelson and Otero soils.

This map unit is used mainly for rangeland. Shallowness and steep slopes are the main limitations in farming and for most other purposes. The potential is fair to poor for wildlife habitat.

8. Valent-Vona-Osgood

Deep, nearly level to moderately sloping, well drained to excessively drained sands and sandy loams formed in eolian deposits

This nearly level to moderately sloping map unit is in the eastern and south-central parts of the survey area, mainly in the sandhill area. It makes up about 36 percent of the total acreage. About 55 percent is Valent soils, 30 percent is Vona soils, 9 percent is Osgood soils, and 6 percent is soils of minor extent.

Valent soils are on the rolling and dunelike topography. Vona soils are on the more gently sloping side slopes along the outer edges of the sandhills. Osgood soils are in the concave, nearly level areas within the sandhills. Valent soils have a sand surface layer and underlying material. Vona soils have a loamy sand or sandy loam surface layer and a sandy loam subsoil.

Minor in this unit are the well drained Olney and Terry soils.

This map unit is used mainly for rangeland. Some small areas are used for irrigated and nonirrigated cropland. Sandy texture is the main limitation in farming. The potential is fair for urban development. The potential is fair to good for wildlife habitat.

9. Aquolls-Aquents-Bankard

Deep, level and nearly level, poorly drained and somewhat excessively drained loamy soils and sandy loams formed in alluvium

This level and nearly level map unit is on flood plains along major streams throughout the survey area. It makes up about 5 percent of the total acreage. About 35 percent is Aquolls, 20 percent is Aquents, 20 percent is Bankard soils, and 25 percent is soils of minor extent.

Aquolls and Aquents form an intermingled complex pattern along the outer limits of the bottom land, or flood plain. Bankard soils are adjacent to the streams. Aquolls and Aquents are poorly drained, and Bankard soils are somewhat excessively drained. Aquolls and Aquents are loamy and have a seasonal high water table. Bankard soils have a sandy loam surface layer and sand underlying material.

Minor in this unit are the poorly drained Aquepts and the well drained Colombo, Haverson, and Nunn soils.

This map unit is used mainly for rangeland and wildlife habitat. Wetness and the hazard of flooding are the main limitations in farming and for most other purposes. The potential is good for development of wetland wildlife habitat. This map unit also has good potential as a source of sand and gravel.

10. Loup-Boel

Deep, level and nearly level, somewhat poorly drained and poorly drained loamy sands formed in sandy alluvium

This level and nearly level map unit is along Lost Creek in the sandhill area and in a small area north of Milton Reservoir. It makes up about 1 percent of the survey area. About 55 percent is Loup soils, 30 percent is Boel soils, and 15 percent is soils of minor extent.

Loup soils are in the lower, or depression, areas that receive additional runoff. Boel soils are at the slightly higher elevations. Loup soils are poorly drained, and Boel soils are somewhat poorly drained. Both soils have a loamy sand surface layer and underlying material and a seasonal high water table.

Minor in this unit are the poorly drained Aquolls, the well drained Osgood soils, and the excessively drained Valent soils.

This map unit is used mainly for rangeland. Wetness and sandy texture are the main limitations in farming. The potential is fair for development of rangeland wildlife habitat.

11. Nunn-Haverson

Deep, level and nearly level, well drained loams and clay loams formed in alluvium

This level and nearly level map unit occupies long narrow flood plains and alluvial fans along the major intermittent streams that disect the southeastern part of the survey area. It makes up about 4 percent of the total acreage. About 45 percent is Nunn soils, 35 percent is Haverson soils, and 20 percent is soils of minor extent.

Nunn soils are on the low terraces and alluvial fans and are slightly higher in elevation than Haverson soils. Haverson soils are on the bottom land and in areas of more recent deposition. Nunn soils have a loam or clay loam surface layer and a clay loam subsoil. Haverson soils have a loam surface layer and underlying material and are stratified.

Minor in this unit are the well drained Colombo, Dacono, and Olney soils and the somewhat excessively drained Bankard soils.

This map unit is used mainly for irrigated and nonirrigated cropland. The soils are well suited to all commonly

grown crops. Unless protected, they are subject to flooding. The potential is fair for development of wildlife habitat.

12. Nunn-Dacono-Altvan

Deep, level and nearly level, well drained loams and clay loams formed in alluvium

This level and nearly level map unit is on high terraces and alluvial fans throughout the survey area. It makes up about 7 percent of the total acreage. About 45 percent is Nunn soils, 15 percent is Dacono soils, 15 percent is Altvan soils, and 25 percent is soils of minor extent.

The soils in this map unit occupy the same relative positions on the landscape (fig. 3). Nunn soils have a loam or clay loam surface layer and a clay loam subsoil. Dacono soils have a clay loam surface layer and subsoil. Altvan soils have a loam surface layer and a sandy clay loam or light clay loam subsoil. Dacono and Altvan soils have sand and gravel underlying material between depths of 20 and 40 inches.

Minor in this unit are the well drained Ascalon, Colombo, and Olney soils.

This map unit is used mainly for irrigated cropland. The potential is only fair to poor for urban development. The main limitations are shrink swell, low strength, and slow permeability of the heavier clay loams. The potential is fair for the development of openland wildlife habitat.

13. Julesburg-Bresser

Deep, level and nearly level, well drained sandy loams formed in alluvium

This level and nearly level map unit is on the higher terraces along the South Platte River in the west-central part of the survey area. It makes up about 1.5 percent of the total acreage. About 45 percent is Julesburg soils, 15 percent is Bresser soils, and 40 percent is soils of minor extent.

The soils in this map unit occupy the same relative positions on the landscape. Julesburg soils have a sandy loam surface layer and subsoil. Bresser soils have a sandy loam surface layer and a sandy clay loam subsoil.

Minor in this unit are the well drained Otero and Olney soils and the excessively drained Valent soils.

This map unit is used mainly for irrigated cropland. The potential is good for urban development and fair for openland wildlife habitat.

Broad land use considerations

Deciding what land should be used for urban development is an important issue in the survey area. Each year a considerable acreage is developed for urban use in Greeley and other cities and areas. The general soil map is most helpful in planning the general outline of urban areas, but it cannot be used in selecting sites for specific urban structures. In general, the soils that have good potential for cultivated crops also have good potential for urban development. The data about specific soils in this survey can be helpful in planning future land use patterns.

Areas where the soils are so unfavorable that urban development is prohibitive are not extensive in the survey area. Most of the Aquolls-Aquents-Bankard map unit is on flood plains where flooding and ponding are severe limitations. The Loup-Boel unit also is wet and poorly drained. The Nunn-Haverson unit is subject to flooding unless protected by dikes. Urban development can be costly on the strongly sloping, shallow soils in the Midway-Shingle and the Tassel-Thedalund-Terry units. Many parts of the Otero-Thedalund-Nelson unit are moderately sloping soils that have bedrock a few feet below the surface, which makes urban development costly. The clayey soils of the Ulm-Nunn and, to a lesser extent, the Nunn-Dacono-Altvan units have poor potential for urban development because of high shrink-swell potential and slow permeability.

In large areas of the county are soils that can be developed for urban use at lower cost than can the soils just mentioned. These include the Olney-Kim-Otero unit, the Julesburg-Bresser unit, and the Valent-Vona-Osgood unit. The Olney-Kim and the Julesburg-Bresser units are excellent farmland. This potential should not be overlooked when broad land uses are considered. The soils in the Valent-Vona-Osgood unit have a sandy surface layer, but other qualities are favorable for urban development.

The Weld-Colby and the Wiley-Colby-Weld units, identified as units 3 and 4 on the general soil map, are excellent farmland but have fair or poor potential for urban development. Weld and Wiley soils have low strength and a moderate shrink-swell potential.

Early potatoes are particularly well suited to soils of the Julesburg-Bresser map unit. These soils are well drained, and they warm up earlier in spring than the heavier soils.

The Aquolls-Aquents-Bankard map unit is an excellent source of sand and gravel. Most of the sand and gravel excavations in the survey area are in these soils.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a

brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have a profile that is almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. Olney and Nunn, for example, are names of two soil series.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Olney fine sandy loam, 1 to 3 percent slopes, is one of several phases within the Olney series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes and undifferentiated groups.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Midway-Shingle complex, 5 to 20 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because there is little value in separating them. The pattern and proportion of the soils are not uniform. An area shown on the map has at least one of the dominant (named) soils or may have all of them. Loup-Boel loamy sands, 0 to 3 percent slopes, is an undifferentiated group in this survey area.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Rock outcrop is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 4, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil descriptions

1—Altvan loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,500 to 4,900 feet. It formed in old alluvium deposited by the major rivers. Included in mapping are small areas of soils that show evidence of poor drainage. Also included are small, long and narrow areas of sand and gravel deposits.

Typically the surface layer of the Altvan soil is grayish brown loam about 10 inches thick. The subsoil is brown and light yellowish brown clay loam and sandy clay loam about 15 inches thick. The substratum is calcareous loamy sand about 6 inches thick over gravelly sand.

Permeability and available water capacity are moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. The high clay content and the rapidly permeable substratum slightly restrict some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common (fig. 4). Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

This soil can produce habitat elements that are highly suitable for openland wildlife, including pheasant, cottontail, and mourning dove. Such crops as wheat, corn, and alfalfa provide suitable habitat for openland wildlife, especially pheasant. Tree and shrub plantings and undisturbed nesting cover would enhance openland wildlife populations.

This Altvan soil has fair to good potential for urban and recreational development. The chief limiting soil features for urban development are the shrink-swell potential of the subsoil as it wets and dries and the rapid permeability of the sand and gravel substratum. Septic tank absorption fields function properly, but in places the substratum does not contain enough fines to properly

filter the leachate. Sewage lagoons require sealing. Lawns, shrubs, and trees grow well. Capability subclass IIs irrigated.

2—Altvan loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,500 to 4,900 feet. It formed in old alluvium deposited by the major rivers. Included in mapping are small areas of soils that show evidence of poor drainage. Also included are small, long and narrow areas of sand and gravel deposits.

Typically the surface layer of this Altvan soil is grayish brown loam about 10 inches thick. The subsoil is brown and light yellowish brown clay loam and sandy clay loam about 14 inches thick. The substratum is calcareous loamy sand about 5 inches thick over gravelly sand.

Permeability and available water capacity are moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water application.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantins of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

This soil can produce habitat elements that are highly suitable for openland wildlife including pheasant, cottontail, and mourning dove. Such crops as wheat, corn, and alfalfa provide suitable habitat for openland wildlife, especially pheasant. Tree and shrub plantings and undisturbed nesting cover would enhance openland wildlife populations.

This Altvan soil has fair to good potential for urban and recreational development. The chief limiting soil features for urban development are the shrink-swell potential of the subsoil as it wets and dries and the rapid permeability of the sand and gravel substratum. Septic tank absorption fields function properly, but in places the substratum does not contain enough fines to properly filter the leachate. Sewage lagoons require sealing. Lawns, shrubs, and trees grow well. Capability subclass IIe irrigated.

3—Aquolls and Aquents, gravelly substratum. This nearly level map unit is on bottom lands and flood plains of all the major streams in the survey area. Aquolls, which have a dark colored surface layer, make up about 60 percent of the unit. Aquents, which have a lighter colored surface layer, make up about 35 percent. About 5 percent is Aquepts and Bankard sandy loam.

These are deep, poorly drained soils that formed in recent alluvium. No one pedon is typical. Commonly the soils have a mottled, mildly alkaline to moderately alkaline loamy or clayey surface layer and underlying material and are underlain by sand or sand and gravel within 48 inches. In places they have a gleyed layer in the underlying material.

Most of the acreage is subject to flooding. The water table is at or near the surface early in spring and recedes to as deep as 48 inches late in fall in some years.

These soils are used for rangeland and wildlife habitat. Some small areas have been reclaimed by major drainage and leveling and are used for irrigated crops.

The potential native vegetation is dominated by alkali sacaton, switchgrass, and western wheatgrass. Saltgrass, sedge, rush, and alkali bluegrass are also prominent. Potential production ranges from 3,000 pounds per acre in favorable years to 2,000 pounds in unfavorable years. As range condition deteriorates, the switchgrass, alkali sacaton, and western wheatgrass decrease and saltgrass, sedge, and rush increase.

Management of vegetation should be based on taking half and leaving half of the total annual production. Seeding is difficult and costly because numerous tillage practices are required to eliminate the saltgrass sod. Switchgrass, western wheatgrass, alkali sacaton, tall wheatgrass, and tall fescue are suitable for seeding. They can be seeded into a clean, firm seedbed. Seedbed preparation usually requires more than 1 year to eliminate the saltgrass sod. A grass drill should be used. Seeding early in spring has proven most successful.

Wetland wildlife, especially waterfowl, utilize this unit. The wetland plants provide nesting and protective cover, as well as some food. The nearby irrigated cropland, where wildlife obtain much of their food and find protective cover, makes this unit valuable to both wetland and openland wildlife.

Openland wildlife, especially pheasant, use this unit for cover and nesting. Deer find excellent cover in some areas.

These valuable wildlife areas should be protected from fire and fenced to prevent encroachment and overuse by livestock. They should not be drained.

These soils have good potential as a source of sand and gravel. Capability subclass VIw; Salt Meadow range site.

4—Aquolls and Aquepts, flooded. This nearly level map unit is in depressions in smooth plains and along the bottoms of natural drainageways throughout the survey area. Aquolls, which have a dark colored surface layer, make up about 55 percent of the unit. Aquepts, which have a lighter colored surface layer, make up about 25 percent. About 20 percent is soils that are well drained and soils that have sandstone or shale within 48 inches of the surface.

These are deep, poorly drained soils that formed in recent alluvium. No one pedon is typical. Commonly the soils have a mottled, mildly to moderately alkaline loamy or clayey surface layer and underlying material that extends to a depth of 60 inches or more. In places they have a gleyed layer in the underlying material.

Most of the acreage is subject to excessive runoff. The water table is at or near the surface in spring and during the peak of the irrigation season.

These soils are used for rangeland and wildlife habitat. Some small areas are irrigated pasture.

The potential native vegetation is dominated by switchgrass, prairie cordgrass, saltgrass, alkali sacaton, big bluestem, indiangrass, western wheatgrass, slender wheatgrass, sedge, and rush. Cattails and bullrush grow in the swampy spots associated with these range sites. Potential production ranges from 4,000 pounds per acre in favorable years to 3,000 pounds in unfavorable years. As range condition deteriorates, the tall and mid grasses decrease, production drops, and saltgrass, sedge, and rush increase. The farming and irrigation in adjacent areas has increased the amount of salts on much of the acreage.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Switchgrass, big bluestem, indiangrass, western wheatgrass, pubescent wheatgrass, intermediate wheatgrass, tall wheatgrass, and tall fescue are suitable for seeding. The plants selected should met the seasonal requirements of livestock. For successful seeding, a firm prepared seedbed is needed. A grass drill should be used. Seeding early in spring has proven most successful. Tillage is needed to eliminate the undesirable vegetation.

Wetland wildlife, especially waterfowl, utilize this unit. The wetland plants provide nesting and protective cover as well as some food. The nearby irrigated cropland, where wildlife obtain much of their food and find protective cover, makes this unit valuable to both wetland and openland wildlife.

Openland wildlife, especially pheasant, use this unit for cover and nesting. Deer find excellent cover in some areas. These valuable wildlife areas should be protected from fire and fenced to prevent encroachment and overuse by livestock. They should not be drained. Capability subclass VIw; Aquolls in Salt Meadow range site, Aquepts in Wet Meadow range site.

5—Ascalon sandy loam, 1 to 3 percent slopes. This is a deep, well drained soil on uplands at elevations of 4,600 to 5,200 feet. It formed in alluvium. Included in mapping are small areas of rock outcrop.

Typically the surface layer is brown sandy loam about 10 inches thick. The subsoil is pale brown and yellowish brown sandy clay loam about 15 inches thick. The substratum to a depth of 60 inches is calcareous fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

If summer fallowed in alternate years, this soil is well suited to winter wheat, barley, and sorghum. Winter wheat is the principal crop. The predicted average yield is 33 bushels per acre. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

Few areas of this Ascalon soil are in major growth and urbanized centers. The shrink-swell potential of the subsoil as it wets and dries is the most limiting soil feature that must be considered in planning homesites and constructing roads. Capability subclass IIIe nonirrigated; Sandy Plains range site.

6—Ascalon sandy loam, 3 to 5 percent slopes. This is a deep, well drained soil on uplands at elevations of 4,600

to 5,200 feet. It formed in alluvium. Included in mapping are small areas of rock outcrop.

Typically the surface layer is brown sandy loam about 8 inches thick. The subsoil is pale brown and yellowish brown sandy clay loam about 10 inches thick. The substratum to a depth of 60 inches is calcareous fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

If summer fallowed in alternate years, this soil is well suited to winter wheat, barley, and sorghum. Winter wheat is the principal crop. The predicted average yield is 33 bushels per acre. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

Few areas of the Ascalon soil are in major growth and urbanized centers. The shrink-swell potential of the subsoil as it wets and dries is the most limiting soil feature that must be considered in planning homesites and constructing roads. Capability subclass IIIe nonirrigated; Sandy Plains range site.

7—Ascalon sandy loam, 5 to 9 percent slopes. This is a deep, well drained soil on uplands at elevations of 4,600 to 5,200 feet. It formed in alluvium. Included in mapping are small areas of rock outcrop and a few areas that have sandstone and shale bedrock shallower than 60 inches. Also included are small eroded areas.

Typically the surface layer of this Ascalon soil is brown sandy loam about 7 inches thick. The subsoil is pale brown and yellowish brown sandy clay loam about 11 inches thick. The substratum to a depth of 60 inches is calcareous fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard is moderate.

Much of the acreage is cultivated. Winter wheat, barley, and sorghum are suited. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Special site location is needed because of slope. Supplemental irrigation may be

needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

Few areas of this Ascalon soil are in major growth and urbanized centers. The shrink-swell potential of the subsoil as it wets and dries is the most limiting soil feature that must be considered in planning homesites and constructing roads. Capability subclass IVe nonirrigated; Sandy Plains range site.

8—Ascalon loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,500 to 4,900 feet. It formed in alluvium deposited by the major rivers in the survey area. Included in mapping are small areas where sand and gravel are within a depth of 60 inches. Also included are small areas of soils that have a clay loam subsoil.

Typcially the surface layer of this Ascalon soil is brown loam about 10 inches thick. The subsoil is brown and yellowish brown sandy clay loam about 15 inches thick. The substratum to a depth 60 inches is calcareous sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Increased population growth in the survey area has resulted in increased homesite construction. The chief limiting soil features for urban development are the shrink-swell potential of the subsoil as it wets and dries and the limited ability of this soil to support a load. Septic tank absorption fields function properly, but community sewage systems should be provided if the population density increases. Because of the moderately rapid permeability of the substratum, sewage lagoons must be sealed. Lawns, shrubs, and trees grow well. Capability class I irrigated.

9—Ascalon loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,500 to 4,900 feet. It formed in alluvium deposited by the major rivers in the survey area. Included in mapping are small areas where sand and gravel are within a depth of 60 inches. Also included are small areas of soils that have a clay loam subsoil.

Typically the surface layer of this Ascalon soil is brown loam about 10 inches thick. The subsoil is brown and yellowish brown sandy clay loam about 15 inches thick. The substratum to a depth of 60 inches is calcareous sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water application.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Increased population growth in the survey area has resulted in increased homesite construction. The chief limiting soil features for urban development are the shrink-swell potential of the subsoil as it wets and dries and the limited ability of this soil to support a load. Septic tank absorption fields function properly, but community sewage systems should be provided if the population density increases. Because of the moderately rapid permeability of the substratum, sewage lagoons must be sealed. Lawns, shrubs, and trees grow well. Capability subclass IIe irrigated.

10—Bankard sandy loam, 0 to 3 percent slopes. This is a deep, somewhat excessively drained soil on flood plains at elevations of 4,450 to 5,000 feet. It formed in stratified recent alluvium along streams and rivers. Included in mapping are numerous sand and gravel bars and small areas of noncalcareous soils.

Typically the surface layer of this Bankard soil is brown sandy loam about 4 inches thick. The underlying material to a depth of 60 inches is pale brown calcareous sand stratified with thin lenses of sandy loam, loam, and fine gravel.

Permeability is moderately rapid. Available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is suited to limited cropping. It is sandy and subject to flooding. Pasture is the best use. Tall wheatgrass, tall fescue, and annual sweetclover are some of the most suitable crops. Light, frequent irrigation by furrows and flooding is best. Commercial fertilizer improves the amount and value of forage produced.

The potential native vegetation is dominated by switchgrass, indiangrass, sand bluestem, sand reedgrass, sideoats grama, needleandthread, and blue grama. Much of this range site includes other soils and vegetation in such a complex pattern that it is difficult to map them separately. Potential production ranges from 2,500 pounds per acre in favorable years to 1,500 pounds in unfavorable years. As range condition deteriorates, the tall and mid grasses decrease; blue grama, sand dropseed, and forbs increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation should be based on taking half and leaving half of the total annual production. Seeding is desirable only in areas large enough to interseed or to prepare a seedbed. Switchgrass, sand bluestem, sand reedgrass, sideoats grama, little bluestem, blue grama, pubescent wheatgrass, and intermediate wheatgrass are suitable for seeding. This soil can be seeded by using an interseeder or a firm, clean sorghum stubble. A grass drill is required. Seeding early in spring has proven most successful.

This soil is generally not suited to the establishment and growth of trees and shrubs. Onsite investigation is needed to determine feasibility and possible tree and shrub species.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, deer and antelope, can be attracted by managing livestock grazing and reseeding where needed.

This soil is not suited to urban or recreational development because of the flood hazard. Capability subclass IVw irrigated, VIw nonirrigated; Sandy Bottom land range site.

11—Bresser sandy loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,700 to 4,800 feet. It formed in alluvium deposited by the South Platte River. Included in mapping are small areas of soils that have sand and gravelly sand in the lower part of the substratum.

Typically the surface layer is grayish brown sandy loam about 11 inches thick. The subsoil is brown and yellowish brown sandy clay loam about 19 inches thick. The substratum to a depth of 60 inches is loamy sand.

Permeability and available water capacity are moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Lawns, shrubs, and trees grow well. The

only limiting features are the rapid permeability in the substratum and the resulting hazard of ground water contamination from sewage lagoons. Capability class I irrigated.

12—Bresser sandy loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,700 to 4,800 feet. It formed in alluvium deposited by the South Platte River. Included in mapping are small areas of soils that have sand and gravelly sand in the lower part of the substratum.

Typically the surface layer is grayish brown sandy loam about 11 inches thick. The subsoil is brown and yellowish brown sandy clay loam about 18 inches thick. The substratum to a depth of 60 inches is loamy sand.

Permeability and available water capacity are moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water application.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Lawns, shrubs, and trees grow well. The only limiting features are the rapid permeability in the substratum and the resulting hazard of ground water contamination from sewage lagoons. Capability subclass IIe irrigated.

13—Cascajo gravelly sandy loam, 5 to 20 percent slopes. This is a deep, excessively drained soil on terrace edges and upland ridges at elevations of 4,600 to 5,200 feet. It formed in very gravelly calcareous alluvium. Included in mapping are small areas of soils that are shallow or moderately deep over sandstone and shale.

Typically the surface layer is brown gravelly sandy loam about 9 inches thick. The upper part of the underlying material is pale brown and light yellowish brown very gravelly sandy loam about 22 inches thick. The lower part to a depth of 60 inches is light yellowish brown very gravelly sand. A layer of strong lime accumulation 22 inches thick is below the surface layer.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow to medium, and the erosion hazard is low.

The potential native vegetation is dominated by little bluestem, sideoats grama, sand reedgrass, blue grama, hairy grama, switchgrass, and needleandthread. Potential production ranges from 1,200 pounds per acre in favorable years to 700 pounds in unfavorable years. As range condition deteriorates, the tall and mid grasses decrease, blue grama and hairy grama increase, and forage production drops.

Management of vegetation should be based on taking half or less of the total annual production. Seeding and mechanical treatment are impractical. Deferred grazing is a practical measure in improving range condition.

Windbreaks and environmental plantings are suited to this soil. Low available water capacity and high calcium content are the principal hazards in establishing trees and shrubs. Weed control is needed to insure establishment and survival of plantings. Supplemental irrigation also may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. The shrubs best adapted are skunkbush sumac and lilac.

Wildlife uses are very limited because this soil lacks potential for producing necessary habitat elements. Because most of the acreage is rangeland, only rangeland wildlife, for example, scaled quail and antelope, are typical. Extreme care is needed in managing livestock grazing in order to provide suitable habitat on this soil.

Steepness is the most limiting soil feature that must be considered in planning homesites and the construction of roads. Other limiting features are the rapid permeability in the substratum and the resulting hazard of ground water contamination from sewage lagoons. Site preparation for environmental plantings such as lawns, shrubs, and trees is difficult because of the high content of gravel and cobbles. Capability subclass VIIs nonirrigated; Gravel breaks range site.

14—Colby loam, 0 to 1 percent slopes. This is a deep, well drained soil on uplands at elevations of 4,850 to 5,050 feet. It formed in calcareous eolian deposits.

Typically the surface layer is pale brown loam about 12 inches thick. The underlying material to a depth of 60 inches is very pale brown silt loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area includ-

ing corn, sugar beets, beans, alfalfa, small grain, potatotes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to this soil. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife.

This soil has good potential for urban and recreational developments. Road design can be modified to compensate for the limited capacity of this soil to support a load. Capability class I irrigated.

15—Colby loam, 1 to 3 percent slopes. This is a deep, well drained soil on uplands at elevations of 4,850 to 5,050 feet. It formed in calcareous eolian deposits.

Typically the surface layer is pale brown loam about 12 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water application.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing may also be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, and rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this soil. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife. Forage production is typically low on rangeland, and grazing management is needed if livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species.

This soil has good potential for urban and recreational development. Road design can be modified to compensate for the limited capacity of this soil to support a load. Capability subclass IIe irrigated, IVe nonirrigated; Loamy Plains range site.

16—Colby loam, 3 to 5 percent slopes. This is a deep, well drained soil on upland hills and ridges at elevations of 4,850 to 5,050 feet. It formed in calcareous eolian deposits. Included in mapping are small areas of soils that have fine sandy loam or loam underlying material.

Typically the surface layer is pale brown loam about 10 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium to rapid, and the erosion hazard is moderate.

In irrigated areas this soil is suited to crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in ir-

rigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, and rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this soil. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife. Forage production is typically low on rangeland, and grazing management is needed if livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species.

This soil has good potential for urban and recreational developments. Road design can be modified to compensate for the limited capacity of this soil to support a load. Capability subclass IIIe irrigated, IVe nonirrigated; Loamy Plains range site.

17—Colby loam, 5 to 9 percent slopes. This is a deep, well drained soil on upland hills and ridges at elevations of 4,850 to 5,050 feet. It formed in calcareous eolian deposits. Included in mapping are small areas of soils that have fine sandy loam or loam underlying material and small areas of soils that are shallow to moderately deep over shale and sandstone.

Typically the surface layer of this Colby soil is pale brown loam about 7 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard is high.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to close grown crops, such as alfalfa, wheat, and barley. This soil also is suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Close grown crops can be irrigated from closely spaced contour ditches or sprinklers. Contour furrows or sprinklers should be used for new crops. Applications of nitrogen and phosphorus help in maintaining good production.

The potential native vegetation is dominated by blue grama. Sideoats grama, little bluestem, western wheatgrass, and sedge are also prominent. Potential production ranges from 1,800 pounds per acre in favorable years to 1,500 pounds in unfavorable years. As range condition deteriorates, the sideoats grama and little bluestem decrease, forage production drops, and blue grama, buffalograss, and several perennial forbs and shrubs increase. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, and pubescent wheatgrass are suitable for seeding. The grass selected should meet the seasonal needs of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Plowing and drilling should be on the contour to minimize runoff and soil losses. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, and rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this soil. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife. Forage production is typically low on rangeland, and grazing

management is needed if livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species.

This soil has good potential for urban and recreational developments. Road design can be modified to compensate for the limited capacity of this soil to support a load. Capability subclass IVe irrigated, VIe nonirrigated; Loamy Slopes range site.

18—Colby-Adena loams, 3 to 9 percent slopes. These gently sloping to moderately sloping soils are on plains, hills, and ridges at elevations of 4,750 to 4,900 feet. The Colby soil, which makes up about 55 percent of the map unit, occupies the steeper, convex parts of the landscape. The Adena soil, about 30 percent of the unit, occupies the less steep, slightly concave parts. About 15 percent is Kim loam and Weld loam.

The Colby soil is deep and well drained. It formed in calcareous eolian deposits. Typically the surface layer is pale brown loam about 7 inches thick. The underlying material to a depth of 60 inches is very pale brown silt loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard is high.

The Adena soil also is deep and well drained and formed in calcareous eolian deposits. Typically the surface layer is brown loam about 6 inches thick. The subsoil is brown and very pale brown clay loam about 3 inches thick. The substratum to a depth of 60 inches is very pale brown silt loam.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

This unit is used for nonirrigated cropland and rangeland. It is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat and is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this unit is dominated by blue grama. Sideoats grama, little bluestem, and western wheatgrass are also prominent. Potential production ranges from 1,800 pounds per acre in favorable years to 1,100 pounds in unfavorable years. As range condition deteriorates, the sideoats grama and little bluestem decrease, forage production drops, and blue grama, buffalograss, and several perennial forbs and shrubs increase. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, bluegrama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Plowing and drilling should be on the contour to minimize runoff and soil losses. Seeding early in spring has proven most successsful. Capability subclass IVe nonirrigated; Colby soil in Loamy Slopes range site, Adena soil in Loamy Plains range site.

19—Colombo clay loam, 0 to 1 percent slopes. This is a deep, well drained soil on flood plains and terraces at elevations of 4,600 to 4,780 feet. It formed in stratified calcareous alluvium. Included in mapping are small areas of soils that have a loam surface layer and some small leveled areas.

Typically the surface layer of this Colombo soil is dark grayish brown clay loam about 14 inches thick. The upper 7 inches of the underlying material is pale brown stratified clay loam and loam. The lower part to a depth of 60 inches is very pale brown loam stratified with thin lenses of fine sand, medium sand, and clay loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

In irrigated areas this soil is suited to crops commonly grown in the area, such as corn, sugar beets, beans, alfalfa, onions, and potatoes.

All methods of irrigation that are common to the area are used. Borders are suitable for small grain, alfalfa, and pasture. Furrow irrigation is used for row crops. Crops respond to application of nitrogen and phosphorus.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

Where this soil is on flood plains and is susceptible to flooding it has poor potential for urban and recreational development. On the higher terraces the potential is fair. Dwelling and road designs need to be modified to increase the capacity of the soil to support a load and to protect it against frost action. Capability subclass IIw irrigated.

20—Colombo clay loam, 1 to 3 percent slopes. This is a deep, well drained soil on flood plains and terraces at elevations of 4,600 and 4,780 feet. It formed in stratified calcareous alluvium. Included in mapping are small areas of soils that have a loam surface layer. Some small leveled areas are also included.

Typically the surface layer of this Colombo soil is dark grayish brown clay loam about 14 inches thick. The upper 7 inches of the underlying material is pale brown stratified clay loam and loam. The lower part to a depth of 60 inches is very pale brown loam stratified with thin lenses of fine sand, medium sand, and clay loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water application.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is well suited to winter wheat, barley, and sorghum if it is summer fallowed in alternate years. Winter wheat is the principal crop. The predicted average yield is 33 bushels per acre. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by western wheatgrass. Blue grama, switchgrass, sand reedgrass, big bluestem, slender wheatgrass, indiangrass, and green needlegrass are also present. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, the tall grasses decrease, blue grama and buffalograss increase, and forage production drops. Undesirable weeds and annuals invade the site and erosion can occur as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Western wheatgrass, switchgrass, sand reedgrass, sideoats grama, pubescent wheatgrass, intermediate wheatgrass, and blue grama are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a firm prepared seedbed. A grass drill should be used. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

Where this soil is on flood plains and is susceptible to flooding, it has poor potential for urban and recreational development. On the higher terraces, potential is fair. Dwelling and road designs may need to be modified to compensate for the limited capacity of this soil to support a load and to protect it against frost action. Capability subclass IIe irrigated, IIIe nonirrigated; Clayey Plains range site.

21—Dacono clay loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,550 to 4,970 feet. It formed in mixed alluvium. Included in mapping are small, long and narrow areas of sand and gravel deposits and some small leveled areas.

Typically the surface layer of this Dacono soil is grayish brown clay loam about 12 inches thick. The subsoil is grayish brown clay loam about 15 inches thick. The substratum is very gravelly sand.

Permeability is moderately slow. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Generally, such characteristics as a high clay content or a rapidly permeable substratum slightly restrict some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail are best suited to this soil. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, good wildlife habitat can be established, benefiting, many kinds of openland wildlife.

This soil has only fair potential for urban and recreational development. Above the sand and gravel substratum the soil has moderate to high shrink swell, low strength, and moderately slow permeability. These features create problems in dwelling and road construction. Excessive permeability in the substratum can cause contamination of the ground water supply from septic tank leach fields. Sewage lagoons need to be lined. Capability subclass IIs irrigated.

22—Dacono clay loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,550 to 4,970 feet. It formed in mixed alluvium. Included in mapping are small, long and narrow areas of sand and gravel deposits and some small leveled areas.

Typically the surface layer of this Dacono soil is grayish brown clay loam about 12 inches thick. The subsoil is grayish brown clay loam about 15 inches thick. The substratum is very gravelly sand.

Permeability is moderately slow. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Generally, such characteristics as a high clay content or a rapidly permeable substratum slightly restrict some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas most of the acreage is in small grain and is summer fallowed in alternate years. Winter wheat is the principal crop. The predicted average yield is 33 bushels per acre. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion.

The potential native vegetation is dominated by western wheatgrass and blue grama. Buffalograss is also present. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Range pitting can help in reducing runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to this soil. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, good wildlife habitat can established, benefiting many kinds of openland wildlife. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has only fair potential for urban and recreational development. Above the sand and gravel substratum the soil has a moderate to high shrink-swell potential, low strength, and moderately slow permeability. These features create problems in dwelling and road construction. Excessive permeability in the substratum can cause contamination of the ground water supply from septic tank leach fields. Sewage lagoons need to be lined. Capability subclass IIe irrigated, IIIc nonirrigated; Clayey Plains range site.

23—Fort Collins loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces and smooth plains at elevations of 4,500 to 5,050 feet. It formed in alluvium modified by thin eolian deposits. Included in mapping are some small leveled areas and few small areas of a soil that is calcareous at the surface.

Typically the surface layer of this Fort Collins soil is grayish brown loam about 10 inches thick. The subsoil is brown and very pale brown clay loam and loam about 20 inches thick. The substratum to a depth of 60 inches is fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing

vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Road design can be modified to compensate for the limited capacity of this soil to support a load. Capability class I irrigated.

24—Fort Collins loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces and plains at elevations of 4,500 to 5,050 feet. It formed in alluvium modified by thin eolian deposits. Included in mapping are some leveled areas and few small areas of a soil that is calcareous at the surface.

Typically the surface layer of this Fort Collins soil is grayish brown loam about 7 inches thick. The subsoil is brown and very pale brown clay loam and loam about 17 inches thick. The substratum to a depth of 60 inches is fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans (fig. 5), alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water applications.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Road design can be modified to compensate for the limited capacity of this soil to support a load. Capability subclass IIe irrigated, IVc nonirrigated; Loamy Plains range site.

25—Haverson loam, 0 to 1 percent slopes. This is a deep, well drained soil on low terraces and flood plains at elevations of 4,500 to 4,800 feet. It formed in stratified calcareous alluvium. Included in mapping are small areas of soils that have fine sandy loam and sandy loam underlying material and small areas of soils that have sand and gravel above 40 inches.

Typically the surface layer of this Haverson soil is grayish brown loam about 8 inches thick. The underlying material to a depth of 60 inches is pale brown loam stratified with thin lenses of loamy sand and clay loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low. The soil is subject to flooding.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, and onions.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are well suited to this soil. Flooding and moisture competition

from grass and weeds are the principal hazards in establishing tree and shrub plantings. Summer fallowing a year in advance in nonirrigated areas and continued cultivation for weed control are needed to insure establishment and survival of plantings. Supplemental irrigation may be needed. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil is poorly suited to urban and recreational development because of the susceptibility to flooding. Capability subclass IIw irrigated.

26—Haverson loam, 1 to 3 percent slopes. This is a deep, well drained soil on low terraces and flood plains at elevations of 4,500 to 4,800 feet. It formed in stratified calcareous alluvium. Included in mapping are small areas of soils that have fine sandy loam and sandy loam underlying material and small areas of soils that have sand and gravel within a depth of 40 inches.

Typically the surface layer of this Haverson soil is grayish brown loam about 4 inches thick. The underlying material to a depth of 60 inches is pale brown loam stratified with thin lenses of loamy sand and clay loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow to medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water applications.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by western wheatgrass. Blue grama, switchgrass, sand reedgrass, big bluestem, slender wheatgrass, indiangrass, and green needlegrass are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the tall grasses decrease, blue grama and buffalograss increase, and forage production drops. Undesirable weeds and annuals invade the site and erosion can occur as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Western wheatgrass, switchgrass, sand reedgrass, sideoats grama, pubescent wheatgrass, intermediate wheatgrass, and blue grama are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a firm prepared seedbed. A grass drill should be used. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are well suited to this soil. Flooding and moisture competition from grass and weeds are the principal hazards in establishing tree and shrub plantings. Summer fallowing a year in advance in nonirrigated areas and continued cultivation for weed control are needed to insure establishment and survival of plantings. Supplemental irrigation may be needed. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil is poorly suited to urban and recreational development because of the susceptibility to flooding. Capability subclass IIe irrigated, IVe nonirrigated; Loamy Plains range site.

27—Heldt silty clay, 1 to 3 percent slopes. This is a deep, moderately well drained soil on plains at elevations of 4,950 to 5,050 feet. It formed in alluvial sediment derived from shale. Included in mapping are small areas of soils that have a clay loam or silt loam subsoil and substratum.

Typically the surface layer is light brownish gray and light yellowish brown silty clay about 7 inches thick. The subsoil is light brownish gray silty clay about 27 inches thick. The substratum to a depth of 60 inches is silty clay.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

In irrigated areas this soil is suited to crops commonly grown in the area, such as corn, sugar beets, beans, alfalfa, and small grain. The high clay content generally restricts some crops.

Most methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 25 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion.

The potential native vegetation is dominated by western wheatgrass and blue grama. Buffalograss is also present. Potential production ranges from 1,000 pounds in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Range pitting can help in reducing runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible. Successful windbreaks require supplemental water.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to this soil. Supplemental water is needed in wildlife habitat development, including the tree and shrub plantings that serve as nesting areas.

This soil has poor potential for urban and recreational development. Slow permeability and high shrink swell create problems in dwelling and road construction. Capability subclass IIs irrigated, IVe nonirrigated; Clayey Plains range site.

28—Heldt silty clay, 3 to 5 percent slopes. This is a deep, moderately well drained soil on plains at elevations of 4,950 to 5,050 feet. It formed in alluvial sediment derived from shale. Included in mapping are small areas of soils that have a clay loam or silt loam subsoil and substratum.

Typically the surface layer is light brownish gray and light yellowish brown silty clay about 7 inches thick. The subsoil is light brownish gray silty clay about 21 inches thick. The substratum to a depth of 60 inches is silty clay.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

In irrigated areas this soil is suited to crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 20 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and mimimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by western wheatgrass and blue grama. Buffalograss is also present. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Range pitting can help in reducing runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings generally are not suited to this soil. Onsite investigation is needed to determine if plantings are feasible. Successful windbreaks require supplemental water.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to this soil. Supplemental water is needed for wildlife habitat development, including tree and shrub plantings that serve as nesting areas.

This soil has poor potential for urban and recreational development. Slow permeabiity and high shrink swell create problems in dwelling and road construction. Capability subclass IIIe irrigated, IVe nonirrigated; Clayey Plains range site.

29—Julesburg sandy loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,700 to 4,800 feet. It formed in alluvium deposited by the South Platte River. Included in mapping are some leveled areas and small areas of soils that have a loamy substratum.

Typically the surface layer of this Julesburg soil is brown sandy loam about 12 inches thick. The subsoil is brown and pale brown sandy loam about 18 inches thick.

The substratum to a depth of 60 inches is loamy sand and sand.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commmonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Generally, such characteristics as the rapidly permeable substratum slightly restrict some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may by needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Lawns, shrubs, and trees grow well. The only limiting feature of this soil is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Capability subclass IIs irrigated.

30—Julesburg sandy loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,700 to 4,800 feet. It formed in alluvium deposited by the South Platte River. Included in mapping are some leveled areas and small areas of soils that have a loamy substratum.

Typically the surface layer of this Julesburg soil is brown sandy loam about 12 inches thick. The subsoil is brown and pale brown sandy loam about 15 inches thick. The substratum to a depth of 60 inches is loamy sand and sand.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water application.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Lawns, shrubs, and trees grow well. The only limiting feature of this soil is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Capability subclass IIe irrigated.

31—Kim loam, 0 to 1 percent slopes. This is a deep, well drained soil on smooth plains and alluvial fans at elevations of 4,900 to 5,250 feet. It formed in mixed eolian deposits and parent sediment from a wide variety of bedrock. Included in mapping are small areas of soils that have loamy sand underlying material.

Typically the surface layer is brown and pale brown about 12 inches thick. The upper 30 inches of the underlying material is pale brown loam. The lower part to a depth of 60 inches is pale brown fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Very few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, Siberian peashrub, lilac, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Increased population growth in the survey area has resulted in increased homesite construction. The chief limiting feature for urban development and road construction is the limited capacity of the soil to support a load. Septic tank absorption fields function properly, but community sewage systems should be provided if the population density increases. Because of the permeability of the substratum, sewage lagoons must be sealed. Lawns, shrubs, and trees grow well. Capability class I irrigated.

32—Kim loam, 1 to 3 percent slopes. This is a deep, well drained soil on smooth plains and alluvial fans at elevations of 4,900 to 5,250 feet. It formed in mixed eolian deposit and parent sediment from a wide variety of bedrock. Included in mapping are small areas of soils that have loamy sand underlying material.

Typically the surface layer is brown and pale brown loam about 12 inches thick. The upper 28 inches of the underlying material is pale brown loam. The lower part to a depth of 60 inches is pale brown fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining (fig. 6), and installing pipelines may be needed for proper water applications.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat and is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Increased population growth in the survey area has resulted in increased homesite construction. The chief limiting soil feature for urban development and road construction is the limited capacity of this soil to support a load. Septic tank absorption fields function properly, but community sewage systems should be provided if the population density increases. Because of the permeability of the substratum, sewage lagoons must be sealed. Lawns, shrubs, and trees grow well. Capability subclass IIe irrigated, IVe nonirrigated; Loamy Plains range site.

33—Kim loam, 3 to 5 percent slopes. This is a deep, well drained soil on plains and alluvial fans at elevations of 4,900 to 5,250 feet. It formed in mixed eolian deposits and parent sediment from a wide variety of bedrock. Included in mapping are small areas of soils that have loamy sand underlying material.

Typically the surface layer is brown and pale brown loam about 10 inches thick. The upper 28 inches of the underlying material is pale brown loam. The lower part to a depth of 60 inches is pale brown fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

In irrigated areas this soil is suited to crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also suggested. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Increased population growth in the survey area has resulted in increased homesite construction. The chief limiting soil feature for urban development and road construction is the limited capacity of this soil to support a load. Septic tank absorption fields function properly, but community sewage systems should be provided if the population density increases. Because of the permeability of the substratum, sewage lagoons must be sealed. Lawns, shrubs, and trees grow well. Capability subclass IIIe irrigated, IVe nonirrigated; Loamy Plains range site.

34—Kim loam, 5 to 9 percent slopes. This is a deep, well drained soil on plains and alluvial fans at elevations of 4,900 to 5,250 feet. It formed in mixed eolian deposits and parent sediment from a wide variety of bedrock. Included in mapping are small areas of soils that have loamy sand underlying material.

Typically the surface layer is brown and pale brown loam about 10 inches thick. The upper 25 inches of the underlying material is pale brown loam. The lower part to a depth of 60 inches is pale brown fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is rapid, and the erosion hazard is moderate.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. This soil also is suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Close grown crops can be irrigated from closely spaced contour ditches or sprinklers. Contour furrows or sprinklers should be used for new crops. Applications of nitrogen and phosphorus help in maintaining good production.

The potential native vegetation is dominated by blue grama. Sideoats grama, little bluestem, western wheatgrass, and sedge are also prominent. Potential production ranges from 1,800 pounds per acre in favorable years to 1,500 pounds in unfavorable years. As range condition deteriorates, the sideoats grama and little bluestem decrease; forage production drops; and blue grama, buffalograss, and several perennial forbs and shrubs increase. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, and pubescent wheatgrass are suitable for seeding. The grass selected should meet the seasonal needs of livestock. It can be seeded into a clean, firm sorghum stubble, or it

can be drilled into a firm prepared seedbed. Plowing and drilling on the contour minimize runoff and soil losses. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Increased population growth in the survey area has resulted in increased homesite construction. The chief limiting soil feature for urban development and road construction is the limited capacity of this soil to support a load. Septic tank absorption fields function properly, but community sewage systems should be provided if the population density increases. Because of the permeability of the substratum, sewage lagoons must be sealed. Lawns, shrubs, and trees grow well. Capability subclass IVe irrigated, VIe nonirrigated; Loamy Plains range site.

35—Loup-Boel loamy sands, 0 to 3 percent slopes. This level to nearly level map unit is on stream bottoms and in drainageways of the sandhills at elevations of 4,550 to 4,750 feet. The Loup soil occupies the lower or depressional areas, which receive additional runoff. It makes up about 55 percent of the unit. The Boel soil occupies the slightly higher elevations. It makes up about 35 percent of the unit. About 10 percent of the unit is Osgood sand and Valent sand.

The Loup soil is deep and poorly drained. It formed in sandy alluvium. Typically the surface layer is very dark grayish brown, mottled loamy sand about 16 inches thick. The upper 24 inches of the underlying material is light brownish gray, mottled loamy sand. The lower part to a depth of 60 inches is light brownish gray, mottled sandy loam.

Permeability is rapid. Available water capacity is moderate. The water table is at or near the surface in spring and about 36 inches below the surface in the fall. Surface runoff is slow, and the erosion hazard is low.

The Boel soil is deep and somewhat poorly drained. It formed in stratified sandy alluvium. Typically the surface layer is grayish brown loamy sand about 14 inches thick. The underlying material to a depth of 60 inches is pale brown and very pale brown, stratified, mottled loamy sand.

Permeabilty is rapid. Available water capacity is moderate. The water table is usually about 24 to 36 inches below the surface. Surface runoff is slow, and the erosion hazard is low.

This unit is used as rangeland and irrigated cropland. Cropping in irrigated areas is limited to the crops tolerant of water and salts. Light, frequent irrigations by furrows and flooding reduce the salts accumulation. Pasture is the best use. Tall wheatgrass, tall fescue, and annual sweetclover are some of the best suited crops. Commercial fertilizers improve the amount and value of forage produced.

The potential native vegetation on this unit is dominated by switchgrass, little bluestem, sand reedgrass, and western wheatgrass. Indiangrass, sand bluestem, prairie cordgrass, slender wheatgrass, alkali sacaton, saltgrass, sedge, and rush are also present. Potential production ranges from 4,000 pounds per acre in favorable years to 3,000 pounds in unfavorable years. As range condition deteriorates, the switchgrass, sand bluestem, indiangrass, little bluestem, and prairie cordgrass decrease and saltgrass, blue grama, sand dropseed, sedge, and rush increase. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this unit should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Switchgrass, sand bluestem, sand reedgrass, western wheatgrass, indiangrass, pubescent wheatgrass, and intermediate wheatgrass are suitable for seeding. The plants selected should meet the seasonal requirements of livestock. They can be seeded into a clean, firm sorghum stubble, or they can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful. Capability subclass IVw irrigated, VIw nonirriated; Sandy Meadow range site.

36—Midway-Shingle complex, 5 to 20 percent slopes. This moderately sloping to strongly sloping map unit is on upland hills and ridges at elevations of 5,050 to 5,250 feet. The Midway soil makes up about 50 percent of the unit, and the Shingle soil about 35 percent. About 15 percent is Renohill clay loam and Tassel fine sandy loam. The Midway soil differs from the Shingle soil in having more than 35 percent clay in the underlying material.

The Midway soil is shallow and well drained. It formed in residuum from calcareous shale. Typically the surface layer is light olive brown clay about 7 inches thick. The underlying material is light brownish gray clay about 6 inches thick. Depth to calcareous clayey shale is about 13 inches.

Permeability is slow. Available water capacity is low. The effective rooting depth is 10 to 20 inches. Surface runoff is rapid, and the erosion hazard is moderate to high.

The Shingle soil also is shallow and well drained and formed in residuum from calcareous shale. Typically the surface layer is grayish brown loam about 6 inches thick. The underlying material is light yellowish brown clay loam about 12 inches thick. Depth to calcareous clayey

shale is about 18 inches. Permeability is moderate. Available water capacity is low. The effective rooting depth is 10 to 20 inches. Surface runoff is medium to rapid, and the erosion hazard is moderate.

This unit is used as rangeland and wildlife habitat. The potential native vegetation is dominated by alkali sacaton, western wheatgrass, and blue grama. Buffalograss, sideoats grama, needleandthread, little bluestem, sedge, winterfat, and fourwing saltbush are also present. Potential production ranges from 800 pounds per acre in favorable years to 500 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this unit should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, alkali sacaton, sideoats grama, little bluestem, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this unit. Because forage production is typically low, grazing management is needed if livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species. The nearby cropland makes areas of this unit valuable as escape cover for openland wildlife, especially pheasants. Capability subclass VIe irrigated, VIe nonirrigated; Shaly Plains range site.

37—Nelson fine sandy loam, 0 to 3 percent slopes. This is a moderately deep, well drained soil on plains at elevations of 4,800 to 5,050 feet. It formed in residuum from soft sandstone. Included in mapping are small areas of soils that have sandstone at a depth of more than 40 inches.

Typically the surface layer is light brownish gray fine sandy loam about 9 inches thick. The underlying material is light olive brown fine sandy loam. Soft sandstone is at a depth of about 30 inches.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is slow to medium, and the erosion hazard is low.

This soil is suited to most of the irrigated crops commonly grown in the area, but it is somewhat restricted because it is only moderately deep. A suitable cropping system is corn, corn for silage, barley, 3 to 4 years of alfalfa, and wheat. This soil is also well suited to irrigated pasture.

Row crops can be irrigated by furrows or sprinklers. Flooding from contour ditches and sprinkling are suitable in irrigating close grown crops and pasture. Small heads of water and short runs help to reduce erosion. Production can be maintained with frequent irrigations and application of barnyard manure and commercial fertilizer. Keeping tillage to a minimum and utilizing crop residue are important.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat and is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreak and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be developed by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

The underlying sandstone is the most limiting feature of this soil. Neither septic tank absorption fields nor sewage lagoons operate properly. Site preparation for dwellings is more costly. Environmental and beautification plantings of trees and shrubs may be difficult to establish. This soil, however, does have good potential for such recreational development as camp and picnic areas and playgrounds. Capability subclass IIIs irrigated, IVe nonirrigated; Sandy Plains range site.

38—Nelson fine sandy loam, 3 to 9 percent slopes. This is a moderately deep, well drained soil on plains at elevations of 4,800 to 5,050 feet. It formed in residuum derived from soft sandstone. Included in mapping are small areas of soils that have sandstone at a depth of more than 40 inches.

Typically the surface layer is light brownish gray fine sandy loam about 8 inches thick. The underlying material is light olive brown fine sandy loam. Soft sandstone is at a depth of about 28 inches.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium to rapid, and the erosion hazard is moderate.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. This soil is also suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Close grown crops can be irrigated from closely spaced contour ditches or sprinklers. Contour furrows or sprinklers should be used for new crops. Applications of nitrogen and phosphorus help in maintaining good production.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited. Onsite investigation is needed to determine if plantings are feasible.

Wildlife is an important secondary use of this soil. The cropland areas provide wildlife habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

The underlying sandstone is the most limiting feature of this soil. Neither septic tank absorption fields nor sewage lagoons operate properly. Site preparation for dwellings is more costly. Environmental and beautification plantings of trees and shrubs may be difficult to establish. This soil, however, does have good potential for such recreational development as camp and picnic areas and playgrounds. Capability subclass IVe irrigated, VIe nonirrigated; Sandy Plains range site.

39—Nunn loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,550 to 5,000 feet. It formed in mixed alluvium. Included in mapping are small, long and narrow areas of sand and gravel deposits and small areas of soil that are subject to occasional flooding. Some small leveled areas are also included.

Typically the surface layer of this Nunn soil is grayish brown loam about 12 inches thick. The subsoil is light brownish gray clay loam about 12 inches thick. The upper part of the substratum is light brownish gray clay loam. The lower part to a depth of 60 inches is brown sandy loam.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has fair to poor potential for urban development. It has moderate to high shrink swell, low strength, and moderately slow permeability. These features create problems in dwelling and road construction. Those areas that have loam or sandy loam in the lower part of the substratum are suitable for septic tank absorption fields and foundations. Some areas are adjacent to streams and are subject to occasional flooding. This soil has fair potential for such recreational development as camp and picnic areas and playgrounds. Capability class I irrigated.

40—Nunn loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,550 to 5,000 feet. It formed in mixed alluvium. Included in mapping are small, long and narrow areas of sand and gravel deposits and small areas of soils that are subject to occasional flooding. Some leveled areas are also included.

Typically the surface layer of this Nunn soil is grayish brown loam about 12 inches thick. The subsoil is light brownish gray clay loam about 12 inches thick. The upper part of the substratum is light brownish gray clay loam. The lower part to a depth of 60 inches is brown sandy loam.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Generally such characteristics as a high clay content or a rapidly permeable substratum slightly restrict some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

Most nonirrigated areas are used for small grain. The soil is summer fallowed in alternate years. Winter wheat is the principal crop. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Such practices as stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has fair to poor potential for urban development. It has moderate to high shrink swell, low strength, and moderately slow permeability. These features create problems in dwelling and road construction. Those areas that have loam or sandy loam in the lower part of the substratum are suitable for septic tank absorption fields and foundations. Some areas of this soil are adjacent to streams and are subject to occasional flooding. The potential is fair for such recreational development as camp and picnic areas and playgrounds. Capability subclass IIe irrigated, IIIc nonirrigated; Loamy Plains range site.

41—Nunn clay loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces and smooth plains at elevations of 4,550 to 5,150 feet. It formed in mixed alluvium and eolian deposits. Included in mapping are small, long and narrow areas of sand and gravel deposits and small areas of soils that are subject to occasional flooding. Some small leveled areas are also included.

Typically the surface layer of this Nunn soil is grayish brown clay loam about 9 inches thick. The subsoil is light brownish gray clay loam about 14 inches thick. The upper part of the substratum is clay loam. The lower part to a depth of 60 inches is sandy loam.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and

have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has fair to poor potential for urban development. It has moderate to high shrink swell, low strength, and moderately slow permeability. These features create problems in dwelling and road construction. Those areas that have loam or sandy loam in the lower part of the substratum are suitable for septic tank absorption fields and foundations. Some areas of this soil are adjacent to streams and are subject to occasional flooding. The potential is fair for such recreational development as camp and picnic areas and playgrounds. Capability class I irrigated.

42—Nunn clay loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces and smooth plains at elevations of 4,550 to 5,150 feet. It formed in mixed alluvium and eolian deposits. Included in mapping are small, long and narrow areas of sand and gravel deposits and small areas of soils that are subject to occasional flooding. Some leveled areas are also included.

Typically the surface layer of this Nunn soil is grayish brown clay loam aobut 9 inches thick. The subsoil is light brownish gray clay loam about 14 inches thick. The upper part of the substratum is light brownish gray clay loam. The lower part to a depth of 60 inches is brown sandy loam.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Generally such characteristics as the high clay content or the rapidly permeable substratum slightly restrict some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas most of the acreage is in small grain and it is summer fallowed in alternate years. Winter wheat is the principal crop. The predicted average yield is 33 bushels per acre. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion.

The potential native vegetation is dominated by western wheatgrass and blue grama. Buffalograss is also present. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation of this soil should be based on taking half and leaving half of the total annual production. Range pitting can help in reducing runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has fair to poor potential for urban development. It has moderate to high shrink swell, low strength, and moderately slow permeability. These features create problems in dwelling and road construction. Those areas that have loam or sandy loam in the lower part of the substratum are suitable for septic tank absorption fields and foundations. Some areas of this soil are adjacent to streams and are subject to occasional flooding. The potential is fair for such recreational development as camp and picnic areas and playgrounds. Capability subclass IIe irrigated, IIIc nonirrigated; Clayey Plains range site.

43—Nunn loamy sand, 0 to 1 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,700 to 4,900 feet. It formed in alluvium along Box Elder Creek. Included in mapping are small areas of soils that have a loamy subsoil and small areas of soils that are subject to rare flooding.

Typically the surface layer of this Nunn soil is brown loamy sand overburden about 9 inches thick. The subsoil is dark to very dark grayish brown clay loam about 21 inches thick. The substratum to a depth of 60 inches is loamy very fine sand, loamy sand, or sand.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

In irrigated areas this soil is suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

Few areas of this Nunn soil are in major growth and urbanized centers. The sandy surface layer, the moderate shrink-swell potential in the subsoil, and the hazard of rare flooding along Box Elder Creek are the chief limiting features for development. Capability subclass IIIe irrigated, IVe nonirrigated.

44—Olney loamy sand, 1 to 3 percent slopes. This is a deep, well drained soil on smooth plains at elevations of 4,600 to 5,200 feet. It formed in mixed outwash deposits. Included in mapping are some small leveled areas.

Typically the surface layer is grayish brown loamy sand about 9 inches thick. The subsoil is yellowish brown and very pale brown sandy clay loam about 15 inches thick. The substratum to a depth of 60 inches is very pale brown, calcareous fine sandy loam.

Permeability and available water capacity are moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

In irrigated areas this soil is suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the the acreage is planted to winter wheat. The predicted average yield is 20 bushels per acre. The soil is usually summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be

attracted by developing livestock watering facilities, managing livestock grazing and reseeding where needed.

This soil has good potential for urban development. The only limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. The loamy sand surface layer is a limitation for recreational development. Once established, the lawns, shrubs, and trees grow well. Capability subclass IIIe irrigated, IVe nonirrigated; Sandy Plains range site.

45—Olney loamy sand, 3 to 5 percent slopes. This is a deep, well drained soil on plains at elevations of 4,600 to 5,200 feet. It formed in mixed outwash deposits. Included in mapping are small areas of soils that have sandstone and shale within a depth of 60 inches and some small leveled areas.

Typically the surface layer of this Olney soil is grayish brown loamy sand about 7 inches thick. The subsoil is yellowish brown and very pale brown sandy clay loam about 14 inches thick. The substratum to a depth of 60 inches is very pale brown, calcareous fine sandy loam.

Permeability and available water capacity are moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard if low.

In irrigated areas this soil is suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Close grown crops and pasture can be irrigated with contour ditches and corrugations. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility and organic matter content is important. Crops respond to barnyard manure and commercial fertilizer.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban development. The only limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. The loamy sand surface layer is a limitation for recreational development. Once established, the lawns, shrubs, and trees grow well. Capability subclass IIIe irrigated, VI nonirrigated; Sandy Plains range site.

46—Olney fine sandy loam, 0 to 1 percent slopes. This is a deep, well drained soil on smooth plains at elevations of 4,600 to 5,200 feet. It formed in mixed outwash deposits. Included in mapping are small areas of soils that have a dark surface layer and some small leveled areas.

Typically the surface layer of this Olney soil is grayish brown fine sandy loam about 10 inches thick. The subsoil is yellowish brown and very pale brown sandy clay loam about 15 inches thick. The substratum to a depth of 60 inches is very pale brown, calcareous fine sandy loam.

Permeability and available water capacity are moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival

are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

Rapid expansion of Greeley and the surrounding area has resulted in urbanization of much of this Olney soil. This soil has good potential for urban and recreational development. The only limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Lawns, shrubs, and trees grow well. Capability class I irrigated.

47—Olney fine sandy loam, 1 to 3 percent slopes. This is a deep, well drained soil on plains at elevations of 4,600 to 5,200 feet. It formed in mixed outwash deposits. Included in mapping are small areas of soils that have a dark surface layer. Some small leveled areas are also included.

Typically the surface layer of this Olney soil is grayish brown fine sandy loam about 10 inches thick. The subsoil is yellowish brown and very pale brown sandy clay loam about 14 inches thick. The substratum to a depth of 60 inches is very pale brown, calcareous fine sandy loam.

Permeability and available water capacity are moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water application. All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, and pubescent wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

Rapid expansion of Greeley and the surrounding area has resulted in urbanization of much of the Olney soil. This soil has good potential for urban and recreational development. The only limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Lawns, shrubs, and trees grow well. Capability subclass IIe irrigated, IVe nonirrigated; Sandy Plains range site.

48—Olney fine sandy loam, 3 to 5 percent slopes. This is a deep, well drained soil on plains at elevations of 4,600 to 5,200 feet. It formed in mixed outwash deposits. Included in mapping are small areas of soils that have a dark surface layer and small areas of soils that have sandstone and shale within a depth of 60 inches.

Typically the surface layer of this Olney soil is grayish brown fine sandy clay loam about 8 inches thick. The subsoil is yellowish brown and very pale brown fine sandy loam about 12 inches thick. The substratum to a depth of 60 inches is very pale brown, calcareous fine sandy loam.

Permeability and available water capacity are moderate. The effective rooting depth is 60 inches or

more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 25 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As condition deteriorates, sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

Rapid expansion of Greeley and the surrounding area has resulted in urbanization of much of this Olney soil. The soil has good potential for urban and recreational development. The only limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Lawns, shrubs, and trees grow well. Capability subclass IIIe irrigated, IVe nonirrigated; Sandy Plains range site.

49—Osgood sand, 0 to 3 percent slopes. This is a deep, well drained soil on smooth plains at elevations of 4,680 to 4,900 feet. It formed in eolian sands. Included in mapping are small areas of soils that have a subsoil within 20 inches of the surface. Also included are small areas of soils that have a loam and sandy clay loam subsoil.

Typically the surface layer of this Osgood soil is grayish brown sand about 22 inches thick. The subsoil is brown sandy loam about 12 inches thick. The substratum to a depth of 60 inches is pale brown loamy sand and sand.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is very slow, and the erosion hazard is low.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. This soil also is suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Closely spaced contour ditches or sprinklers can be used in irrigating close grown crops. Contour furrows or sprinklers should be used for new crops. Applications of nitrogen and phosphorus help in maintaining good production.

The potential vegetation on this soil is dominated by sand bluestem, sand reedgrass, switchgrass, sideoats grama, needleandthread, little bluestem, and blue grama. Potential production ranges from 2,500 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, switchgrass, sand reedgrass, sideoats grama, and little bluestem decrease; forage production drops; and sand sage increases. Undesirable weeds and annuals invade and "blowout" conditions can occur as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, indiangrass, switchgrass, sideoats grama, little bluestem, and blue grama are suitable for seeding. Because this soil is susceptible to soil blowing, the grasses should be seeded with an interseeder

or drilled into a firm, clean sorghum stubble. Seeding early in spring has proven most successful. Brush management can also help to improve deteriorated range.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal hazards in establishing trees and shrubs. This soil is so loose that trees should be planted in shallow furrows, and vegetation is needed between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

Few areas of this soil are in major growth and urbanized centers. The chief limiting feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from seepage. Potential for recreation is poor because of the sandy surface layer. Capability subclass IVe irrigated, VIe nonirrigated; Deep Sand range site.

50—Otero sandy loam, 0 to 1 percent slopes. This is a deep, well drained soil on smooth plains at elevations of 4,700 to 5,250 feet. It formed in mixed outwash and eolian deposits. Included in mapping are small areas of soils that have loam and clay loam underlying material.

Typically the surface layer is brown sandy loam about 12 inches thick. The underlying material to a depth of 60 inches is pale brown calcareous fine sandy loam.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Generally, such characteristics as a high clay content or a rapidly permeable substratum slightly restrict some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

Rapid expansion of Greeley and the surrounding area has resulted in urbanization of much of this Otero soil. This soil has excellent potential for urban and recreational development. The only limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Lawns, shrubs, and trees grow well. Capability subclass IIs irrigated.

51—Otero sandy loam, 1 to 3 percent slopes. This is a deep, well drained soil on plains at elevations of 4,700 to 5,250 feet. It formed in mixed outwash and eolian deposits. Included in mapping are small areas of soils that have loam and clay loam underlying material.

Typically the surface layer is brown sandy loam about 12 inches thick. The underlying material to a depth of 60 inches is pale brown calcareous fine sandy loam.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area. Land leveling, ditch lining, and installing pipelines may be needed for proper water application.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitaiton is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass,

and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

Rapid expansion of Greeley and the surrounding area has resulted in urbanization of much of this Otero soil. This soil has excellent potential for urban and recreational development. The only limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Lawns, shrubs, and trees grow well. Capability subclass IIIe irrigated, IVe nonirrigated; Sandy Plains range site.

52—Otero sandy loam, 3 to 5 percent slopes. This is a deep, well drained soil on plains at elevations of 4,700 to 5,250 feet. It formed in mixed outwash and eolian deposits. Included in mapping are small areas of soils that have loam and clay loam underlying material. Also included are small areas of soils that have sandstone and shale within a depth of 60 inches.

Typically the surface layer of this Otero soil is brown sandy loam about 10 inches thick. The underlying material to a depth of 60 inches is pale brown calcareous fine sandy loam.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close growing crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

The potential native vegetation on this site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease, and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

Rapid expansion of Greeley and the surrounding area has resulted in urbanization of much of this Otero soil. The soil has excellent potential for urban and recreational development. The only limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Lawns, shrubs, and trees grow well. Capability subclass IIIe irrigated, VIe nonirrigated; Sandy Plains range site.

53—Otero sandy loam, 5 to 9 percent slopes. This is a deep, well drained soil on plains at elevations of 4,700 to 5,250 feet. It formed in mixed outwash and eolian

deposits. Included in mapping are small areas of soils that have sandstone and shale within a depth of 60 inches.

Typically the surface layer is brown sandy loam about 10 inches thick. The underlying material to a depth of 60 inches is pale brown calcareous fine sandy loam.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium to rapid, and the erosion hazard is low.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. This soil also is suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Closely spaced contour ditches or sprinklers can be used in irrigating close grown crops. Contour furrows or sprinklers should be used for new crops. Applications of nitrogen and phosphorus help in maintaining good production.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

Rapid expansion of Greeley and the surrounding area has resulted in urbanization of much of this Otero soil. This soil has excellent potential for urban and recreational development. The primary limiting feature is the moderately rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. There are additional costs in site preparation because of slope. Lawns, shrubs, and trees grow well. Capability subclass IVe irrigated, VIe nonirrigated; Sandy Plains range site.

54—Paoli loam, 0 to 1 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,700 to 5,250 feet. It formed in alluvial deposits. Included in mapping are small areas of soils that have a loamy sand surface layer.

Typically the surface layer is grayish brown loam and fine sandy loam about 25 inches thick. The underlying material to a depth of 60 inches is light brownish gray fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is very slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Such characteristics as the rapidly permeable substratum slightly restrict some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation water management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

In areas protected from flooding, this soil has good potential for urban and recreational development. The chief limiting feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Road designs should be modified to compensate for the moderate frost potential.

Lawns, shrubs, and trees grow well. Capability subclass IIs irrigated.

55—Paoli loam, 1 to 3 percent slopes. This is a deep, well drained soil on terraces at elevations of 4,700 to 5,250 feet. It formed in alluvial deposits. Included in mapping are small areas of soils that have a loamy sand surface layer.

Typically the surface layer is grayish brown loam about 22 inches thick. The underlying material to a depth of 60 inches is light brownish gray fine sandy loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water application.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

This soil is well suited to winter wheat, barley, and sorghum if it is summer fallowed in alternate years. Winter wheat is the principal crop. The predicted average yield is 33 bushels per acre. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by western wheatgrass. Blue grama, switchgrass, sand reedgrass, big bluestem, slender wheatgrass, indiangrass, and green needlegrass are also present. Potential production ranges from 3,000 pounds per acre in favorable years to 2,000 pounds in unfavorable years. As range condition deteriorates, the tall grasses decrease, blue grama and buffalograss increase, and forage production drops. Undesirable weeds and annuals invade and erosion can occur as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Western wheatgrass, switchgrass, sand reedgrass, sideoats grama, pubescent wheatgrass, intermediate wheatgrass, and blue grama are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a firm, prepared seedbed. A grass drill should be used. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. The primary limiting feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Road designs should be modified to compensate for the moderate frost potential. Lawns, shrubs, and trees grow well. Capability subclass IIe irrigated, IIIe nonirrigated; Overflow range site.

56—Renohill clay loam, 0 to 3 percent slopes. This is a moderately deep, well drained soil on plains at elevations of 4,850 to 5,200 feet. It formed in residuum from shale. Included in mapping are small areas of soils that have shale deeper than 40 inches.

Typically the surface layer is grayish brown clay loam about 9 inches thick. The subsoil is grayish brown and pale brown clay loam about 14 inches thick. The substratum is pale brown clay loam. Shale is at a depth of about 32 inches.

Permeability is slow. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is moderate.

This soil is suited to most of the irrigated crops commonly grown in the area, but the high clay content and moderate depth of the soil slightly restrict some crops. A suitable cropping system is corn, corn for silage, barley, 3 to 4 years of alfalfa, and wheat. This soil is also well suited to irrigated pasture.

Furrows can be used in irrigating row crops. Flooding from contour ditches is suitable for close grown crops and pasture. Production can be maintained by applying barnyard manure and commercial fertilizer. Keeping tillage to a minimum and utilizing crop residue are important.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 25 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion.

The potential native vegetation is dominated by western wheatgrass and blue grama. Buffalograss is also present. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable

years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Range pitting can reduce runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreak and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible. Supplemental water is needed for successful plantings.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasant, undisturbed nesting is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has poor potential for urban uses and only moderate potential for recreational development. The chief limiting features are the underlying shale, the low strength, and the moderate to high shrink swell. These features present severe problems in dwelling and road construction and in use of septic tank absorption fields and sewage lagoons. Capability subclass IIIs irrigated, IVe nonirrigated; Clayey Plains range site.

57—Renohill clay loam, 3 to 9 percent slopes. This is a moderately deep, well drained soil on upland hills and ridges at elevations of 4,850 to 5,200 feet. It formed in residuum from shale. Included in mapping are small areas of soils that have shale deeper than 40 inches.

Typically the surface layer is grayish brown clay loam about 9 inches thick. The subsoil is grayish brown and pale brown clay loam about 12 inches thick. The substratum is pale brown clay loam. Shale is at a depth of about 29 inches.

Permeability is slow. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium to rapid, and the erosion hazard is moderate.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. The soil also is suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Closely spaced contour ditches can be used in irrigating close grown crops. Contour furrows should be used for row crops. Applications of barnyard manure and commercial fertilizer help to maintain good production. Keeping tillage to a minimum and utilizing crop residue are important.

The potential native vegetation is dominated by western wheatgrass and blue grama. Buffalograss is also present. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Range pitting can reduce runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible. Supplemental water is needed for successful plantings.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has poor potential for urban and recreational development. The chief limiting features are the underlying shale, the low strength, and the moderate to high shrink swell. These features present severe problems in dwelling and road construction and in use of septic tank absorption fields and sewage lagoons. Capability subclass IVe irrigated, VIe nonirrigated; Clayey Plains range site.

58—Shingle loam, 1 to 3 percent slopes. This is a shallow, well drained soil on plains at elevations of 4,850 to 5,200 feet. It formed in residuum from shale. Included in mapping are some small areas of shale and sandstone outcrops.

Typically the surface layer is grayish brown loam about 6 inches thick. The underlying material is light yellowish brown clay loam. Shale is at a depth of about 18 inches.

Permeability is moderate. Available water capacity is low. The effective rooting depth is 10 to 20 inches. Surface runoff is medium, and the erosion hazard is low.

This soil is suited only to limited cropping. A suitable cropping system is 3 to 4 years of alfalfa and 2 years of

small grain or irrigated pasture. This soil has severe restrictions and requires very careful management. Most irrigation methods are suitable, but the length of runs should be short to prevent overirrigation. Light, frequent irrigations are best. Barnyard manure and commercial fertilizer are needed for normal yields.

The potential native vegetation is dominated by alkali sacaton, western wheatgrass, and blue grama. Buffalograss, sideoats grama, needleandthread, little bluestem, sedge, winterfat, and fourwing saltbush are also present. Potential production ranges from 800 pounds per acre in favorable years to 500 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, alkali sacaton, sideoats grama, little bluestem, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this soil. Because forage production is typically low, grazing management is needed if livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species.

This soil has poor potential for urban development. The chief limiting feature is the shallow depth to shale. Capability subclass IVs irrigated, VIs nonirrigated; Shaly Plains range site.

59—Shingle loam, 3 to 9 percent slopes. This is a shallow, well drained soil on upland hills and ridges at elevations of 4,850 to 5,200 feet. It formed in residuum from shale. Included in mapping are some small outcrops of shale and sandstone.

Typically the surface layer is grayish brown loam about 4 inches thick. The underlying material is light yellowish brown clay loam about 10 inches thick. Shale is at a depth of about 16 inches.

Permeability is moderate. Available water capacity is low. The effective rooting depth is 10 to 20 inches. Surface runoff is medium to rapid, and the erosion hazard is moderate.

The potential native vegetation on this soil is dominated by alkali sacaton, western wheatgrass, and blue grama. Buffalograss, sideoats grama, needleandthread, little bluestem, sedge, winterfat, and fourwing saltbush are also present. Potential production ranges from 800 pounds per acre in favorable years to 500 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, alkali sacaton, sideoats grama, little bluestem, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this soil. Because forage production is typically low, grazing management is needed if livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species.

This soil has poor potential for urban and recreational development. The chief limiting feature is the shallow depth to shale. Capability subclass VIe irrigated, VIe nonirrigated; Shaly Plains range site.

60—Shingle-Renohill complex, 3 to 9 percent slopes. This gently sloping to moderately sloping map unit is on plains, hills, and ridges at elevations of 4,600 to 4,750 feet. The Shingle soil makes up about 65 percent of the unit, and the Renohill soil about 25 percent. About 10 percent is Tassel fine sandy loam. The Shingle soil occupies the steeper, convex parts of the landscape, and the Renohill soil occupies the less steep, slightly concave positions.

The Shingle soil is shallow and well drained. It formed in residuum from calcareous shale. Typically the surface layer is grayish brown loam about 6 inches thick. The underlying material is light yellowish brown clay loam. Calcareous clayey shale is at a depth of about 18 inches.

Permeability is moderate. Available water capacity is low. The effective rooting depth is 10 to 20 inches. Surface runoff is medium to rapid, and the erosion hazard is moderate.

The Renohill soil is moderately deep and well drained. It formed in residuum from shale. Typically the surface layer is grayish brown clay loam about 9 inches thick. The subsoil is grayish brown and pale brown clay loam about 14 inches thick. The substratum is clay loam. Shale is at a depth of about 32 inches.

Permeability is slow. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is rapid, and the erosion hazard is moderate.

This unit is used for rangeland and wildlife habitat. The potential native vegetation on the Shingle soil is dominated by alkali sacaton, western wheatgrass, and blue grama. Buffalograss, sideoats grama, needleandthread, little bluestem, sedge, winterfat, and fourwing saltbrush are also present. Potential production ranges

from 800 pounds per acre in favorable years to 500 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on the Shingle soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, alkali sacaton, sideoats grama, little bluestem, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

The potential native vegetation on the Renohill soil is dominated by western wheatgrass and blue grama. Buffalograss is also presented. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on the Renohill soil should be based on taking half and leaving half of the total annual production. Range pitting can reduce runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this unit. Because forage production is typically low, grazing management is needed if livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species. Capability subclass VIe irrigated, VIe nonirrigated; Shingle soil in Shaly Plains range site, Renohill soil in Clayey Plains range site.

61—Tassel fine sandy loam, 5 to 20 percent slopes. This is a shallow, well drained soil on upland breaks at elevations of 4,850 to 5,200 feet. It formed in residuum from sandstone. Included in mapping are small areas of sandstone outcrop and areas of noncalcareous soils.

Typically the surface layer of this Tassel soil is light yellowish brown fine sandy loam about 7 inches thick. The underlying material is light yellowish brown very fine sandy loam. Sandstone is at a depth of about 11 inches.

Permeability is moderately rapid. Available water capacity is low. The effective rooting depth is 10 to 20 inches. Surface runoff is medium, and the erosion hazard is moderate.

The potential native vegetation is dominated by sideoats grama, little bluestem, blue grama, threadleaf sedge, sand reedgrass, and needleandthread. Potential production ranges from 1,750 pounds per acre in favorable years to 950 pounds in unfavorable years. As range condition deteriorates, the sideoats grama, little bluestem, and sand reedgrass decrease; yucca, sedge, and blue grama increase; and forage production drops.

Management of vegetation should be based on taking half or less of the total annual production. Deferred grazing is practical in improving range condition. Seeding and mechanical treatment are impractical.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Production of vegetation on this treeless soil is low, especially during drought, when annual production can be as low as 300 pounds per acre. Rangeland wildlife, such as antelope and scaled quail, can be attracted by managing livestock grazing, installing livestock watering facilities, and reseeding where needed.

This soil has poor potential for urban development. The chief limiting feature is the shallow depth to sandstone. Capability subclass VIe irrigated, VIe nonirrigated; Sandstone Breaks range site.

62—Terry fine sandy loam, 0 to 3 percent slopes. This is a moderately deep, well drained soil on plains at elevations of 4,500 to 5,000 feet. It formed in residuum from sandstone. Included in mapping are small areas of soils that have sandstone deeper than 40 inches. Also included are small areas of soils that have a subsoil of sandy clay loam and clay loam.

Typically the surface layer of this Terry soil is pale brown fine sandy loam about 6 inches thick. The subsoil is pale brown fine sandy loam about 21 inches thick. The substratum is very pale brown fine sandy loam. Sandstone is at a depth of about 37 inches.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is slow, and the erosion hazard is low.

This soil is suited to most of the irrigated crops commonly grown in the area. The moderate depth restricts some crops. A suitable cropping system is corn, corn for silage, barley, 3 to 4 years of alfalfa, and wheat. This soil is also well suited to irrigated pasture.

Furrows or sprinklers can be used in irrigating row crops. Flooding from contour ditches and sprinkling are suitable in irrigating close grown crops and pasture. Small heads of water and short runs reduce the risk of erosion. Production can be maintained by frequent irrigations and by applications of barnyard manure and commercial fertilizer. Keeping tillage to a minimum and utilizing crop residue are important.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 25 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

The underlying sandstone is the most limiting feature of this soil. Neither septic tank absorption fields nor sewage lagoons function properly. Site preparation for dwellings is costly. Enviornmental and beautification plantings of trees and shrubs can be difficult to establish. Potential is good, however, for such recreational development as camp and picnic areas and playgrounds. Capability subclass IVe irrigated, IVe nonirrigated; Sandy Plains range site.

63—Terry fine sandy loam, 3 to 9 percent slopes. This is a moderately deep, well drained soil on plains at elevations of 4,500 to 5,000 feet. It formed in residuum from sandstone. Included in mapping are small areas of soils that have sandstone deeper than 40 inches. Also included are small areas of soils that have a sandy clay loam and clay loam subsoil.

Typically the surface layer of this Terry soil is pale brown fine sandy loam about 6 inches thick. The subsoil is pale brown fine sandy loam about 18 inches thick. The substratum is fine sandy loam. Sandstone is at a depth of about 32 inches.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium to rapid, and the erosion hazard is moderate.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. The soil is also suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Closely spaced contour ditches or sprinklers can be used in irrigating close grown crops. Contour furrows or sprinklers should be used for new crops. Applications of nitrogen and phosphorus help in maintaining good production.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially, in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

The underlying sandstone is the most limiting feature of this soil. Neither septic tank absorption fields nor sewage lagoons function properly. Site preparation for dwellings is costly. Environmental and beautification plantings of trees and shrubs can be difficult to establish. Potential is good, however, for such recreational development as camp and picnic areas. Capability subclass IVe irrigated, VIe nonirrigated; Sandy Plains range site.

64—Thedalund loam, 1 to 3 percent slopes. This is a moderately deep, well drained soil on plains at elevations of 4,900 to 5,250 feet. It formed in residuum from shale. Included in mapping are small areas of soils that have shale and sandstone deeper than 40 inches.

Typically the surface layer is brown loam about 8 inches thick. The underlying material is pale brown and very pale brown loam. Shale is at a depth of about 28 inches.

Permeability and available water capacity are moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium, and the erosion hazard is low.

This soil is suited to limited cropping. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop. Incorporating plant residue and manure improves tilth and provides organic matter and plant nutrients.

Most irrigation methods are suitable, but the length of runs should be short to prevent overirrigation. Light, frequent irrigations are best. Sprinkler irrigation is desirable. Commercial fertilizers increase yields and add to the value of the forage produced.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 25 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this soil. Because forage production is typically low, grazing management is needed if livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species. The cropland areas provide favorable habitat for pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover.

The underlying shale is the most limiting feature of this soil. Neither septic tank absorption fields nor sewage lagoons function properly. In places the underlying shale has high shrink-swell potential. Environmental and beautification plantings of trees and shrubs can be difficult to establish. Capability subclass IVs irrigated; IVe nonirrigated; Loamy Plains range site.

65—Thedalund loam, 3 to 9 percent slopes. This is a moderately deep, well drained soil on plains at elevations of 4,900 to 5,250 feet. It formed in residuum from shale. Included in mapping are small areas of soils that have shale and sandstone deeper than 40 inches. Some small outcrops of shale and sandstone are also included.

Typically the surface layer of this Thedalund soil is brown loam about 8 inches thick. The underlying material is pale brown and very pale brown loam. Shale is at a depth of about 25 inches.

Permeability and available water capacity are moderate. The effective rooting depth is 20 to 40 inches. Surface runoff is medium to rapid, and the erosion hazard is moderate.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. The soil is also suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Closely spaced contour ditches or sprinklers can be used in irrigating close grown crops. Contour furrows or sprinklers should be used for new crops. Application of commercial fertilizer helps in maintaining good production.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Rangeland wildlife, such as antelope, cottontail, and coyote, are best suited to this soil. Because forage production is typically low, grazing management is needed if

livestock and wildlife share the range. Livestock watering facilities also are utilized by various wildlife species. The cropland areas provide favorable habitat for pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover.

The underlying shale is the most limiting feature of this soil. Neither septic tank absorption fields nor sewage lagoons function properly. In places the underlying shale has high shrink-swell potential. Environmental and beautification plantings of trees and shrubs can be difficult to establish. Capability subclass IVe irrigated, VIe nonirrigated; Loamy Plains range site.

66—Ulm clay loam, 0 to 3 percent slopes. This is a deep, well drained soil on plains at elevations of 5,075 to 5,200 feet. It formed in alluvial and eolian sediments from shale. Included in mapping are small areas of soils that have shale between 40 and 60 inches. Also included are small areas of soils where the surface layer and subsoil have been recharged with lime from irrigation.

Typically the surface layer of this Ulm soil is brown clay loam about 5 inches thick. The subsoil is brown and pale brown clay about 14 inches thick. The substratum to a depth of 60 inches is clay and clay loam.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, and small grain. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines are needed for proper water applications.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by western wheatgrass and blue grama. Buffalograss is also present. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Range pitting can reduce runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commmonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has poor potential for urban and recreational development. Slow permeability and high shrink swell cause problems in dwelling and road construction. Capability subclass IIe irrigated, IVe nonirrigated; Clayey Plains range site.

67—Ulm clay loam, 3 to 5 percent slopes. This is a deep, well drained soil on plains at elevations of 5,075 to 5,200 feet. It formed in alluvial and eolian sediments from shale. Included in mapping are small areas of soils that have shale between depths of 40 and 60 inches. Also included are small areas of soils where the surface layer and subsoil have been recharged with lime from irrigation.

Typically the surface of this Ulm soil is brown clay loam about 5 inches thick. The subsoil is brown and pale brown clay about 12 inches thick. The substratum to a depth of 60 inches is clay and clay loam.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

In irrigated areas this soil is suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years

to allow moisture accumulation. Generally precipitation is too low to make beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by western wheatgrass and blue grama. Buffalograss is also present. Potential production ranges from 1,000 pounds per acre in favorable years to 600 pounds in unfavorable years. As range condition deteriorates, a blue grama-buffalograss sod forms. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Range pitting can reduce runoff. Seeding is desirable if the range is in poor condition. Western wheatgrass, blue grama, sideoats grama, buffalograss, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has poor potential for urban and recreational development. Slow permeability and high shrink swell cause problems in dwelling and road construction. Capability subclass IIIe irrigated, IVe nonirrigated; Clayey Plains range site.

68—Ustic Torriorthents, moderately steep. These are deep, excessively drained soils on terrace breaks and escarpments at elevations of 4,450 to 5,100 feet. They formed in gravelly alluvium and have slopes of 9 to 25 percent. Included in mapping are small areas of soils that have pockets of sandy loam and loam in the underlying material.

Typically the surface layer is pale brown gravelly sand about 10 inches thick. The underlying material to a depth of 60 inches is pale brown gravelly sand.

Permeability is rapid. Available water capacity is low. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

The potential native vegetation is dominated by little bluestem, sideoats grama, sand reedgrass, blue grama, hairy grama, switchgrass, and needleandthread. Potential production ranges from 700 pounds per acre in favorable years to 200 pounds in unfavorable years. As range condition deteriorates, the tall and mid grasses decrease, blue grama and hairy grama increase, and forage production drops.

Management of vegetation should be based on taking half or less of the total annual production. Deferred grazing is practical in improving range condition. Seeding and mechanical treatment are impractical.

Windbreaks and environmental plantings generally are not suited to these soils. Onsite investigation is needed to determine if plantings are feasible.

Wildlife populations are limited because the necessary habitat elements are lacking. Because most of the acreage is rangeland, only rangeland wildlife, for example scaled quail and antelope, are typical. Extreme care is needed in managing livestock grazing in order to provide suitable habitat on these soils.

Potential is poor for urban and recreational development. The chief limiting soil features are the loose, coarse textured soil, steep slopes, and rapid permeability. Capability subclass VIIs irrigated, VIIs nonirrigated; Gravel Breaks range site.

69—Valent sand, 0 to 3 percent slopes. This is a deep, excessively drained soil on plains at elevations of 4,650 to 5,100 feet. It formed in eolian deposits. Included in mapping are small areas of soils that have lime within a depth of 40 inches.

Typically the surface layer is brown sand about 8 inches thick. The underlying material to a depth of 60 inches is brown sand.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is suited to limited cropping. Intensive cropping is hazardous because of erosion. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. The soil also is suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Closely spaced contour ditches or sprinkers can be used in irrigating close grown crops. Contour furrows or sprinklers should be used for new crops. Applications of barnyard manure and commercial fertilizer help to maintain good production.

The potential vegetation is dominated by sand bluestem, sand reedgrass, switchgrass, sideoats grama, needleandthread, little bluestem, and blue grama. Potential production ranges from 2,500 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As

range condition deteriorates, the sand bluestem, switchgrass, sand reedgrass, sideoats grama, and little bluestem decrease, forage production drops, and sand sage increases. Undesirable weeds and annuals invade and "blowout" conditions can occur as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, indiangrass, switchgrass, sideoats grama, little bluestem, and blue grama are suitable for seeding. Because this soil is susceptible to soil blowing, it should be seeded using an interseeder, or the seed should be drilled into a firm, clean sorghum stubble. Seeding early in spring has proven most successful. Brush management also can help in improving deteriorated range.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and the moderate available water capacity are the principal hazards in establishing trees and shrubs. The soil is so loose that trees should be planted in shallow furrows, maintaining vegetation between the rows. Supplemental irrigation is needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has fair potential for urban development. The primary limiting soil features are the rapid permeability and the susceptibility to soil blowing. Septic tank absorption fields function properly, but in places the sandy substratum does not properly filter the leachate. Sewage lagoons must be sealed. Once established, the lawns, shrubs, and trees grow well. Capability subclass IVe irrigated, VIe nonirrigated; Deep Sand range site.

70—Valent sand, 3 to 9 percent slopes. This is a deep, excessively drained soil on plains at elevations of 4,650 to 5,100 feet. It formed in eolian deposits. Included in mapping are small areas of soils that have lime within a depth of 40 inches. Also included are small areas of soils that have sandstone between 40 and 60 inches.

Typically the surface layer of the Valent soil is brown sand about 6 inches thick. The underlying material to a depth of 60 inches is brown sand.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

The potential vegetation is dominated by sand bluestem, sand reedgrass, switchgrass, sideoats grama, needleandthread, little bluestem, and blue grama. Potential production ranges from 2,500 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, switchgrass, sand reedgrass, sideoats grama, and little bluestem decrease, forage production drops, and sand sage increases. Undesirable weeds and annuals invade and "blowout" conditions can occur as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, indiangrass, switchgrass, side-oats grama, little bluestem, and blue grama are suitable for seeding. Because this soil is susceptible to soil blowing, it should be seeded using an interseeder or the seed should be drilled into a firm, clean sorghum stubble. Seeding early in spring has proven most successful. Brush management can also help in improving deteriorated range.

Windbreaks and environmental plantings are generally not suited to this soil. Onsite investigation is needed to determine if plantings are feasible.

Wildlife is an important secondary use of this soil. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has fair potential for urban development. The chief limiting soil features are the rapid permeability and the susceptibility to soil blowing. Septic tank absorption fields function properly, but in places the sandy substratum does not properly filter the leachate. Sewage lagoons must be sealed. Once established, lawns, shrubs, and trees grow well. Capability subclass VIe irrigated, VIe nonirrigated; Deep Sand range site.

71—Valent-Loup complex, 0 to 9 percent slopes. This level to moderately sloping map unit occupies hills, ridges, and depression or pothole-like areas in the sandhills at elevations of 4,670 to 4,700 feet. The Valent soil makes up about 60 percent of the unit, the Loup soil about 35 percent. About 5 percent is dune sand. The Valent soil occupies the hills and ridges and the Loup soil the depressions or potholes.

The Valent soil is deep and excessively drained. It formed in eolian deposits. Typically the surface layer is brown sand about 8 inches thick. The underlying material to a depth of 60 inches is brown sand.

Permeability is rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

The Loup soil is deep and poorly drained. It formed in sandy alluvium. Typically the surface layer is very dark grayish brown, mottled loamy sand about 16 inches thick. The underlying material to a depth of 60 inches is light brownish gray, mottled loamy sand and sandy loam.

Permeability is rapid. Available water capacity is moderate. A water table is at or near the surface in spring and about 36 inches below the surface in fall. Surface runoff is slow, and the erosion hazard is low.

This unit is used for rangeland and wildlife habitat. The potential native vegetation on the Valent soil is dominated by sand reedgrass, sand bluestem, blue and hairy grama, little bluestem, needleandthread, and sideoats grama. Potential production ranges from 1,800 pounds per acre in favorable years to 1,400 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, sideoats grama, and little bluestem decrease; sandhill muhly and blowout grass increase, and forage production drops. "Blowouts" occur as range condition becomes poorer.

The native vegetation on the Loup soil is dominated by switchgrass, little bluestem, sand reedgrass, and western wheatgrass. Indiangrass, sand bluestem, prairie cordgrass, slender wheatgrass, alkali sacaton, saltgrass, sedge, and rush are also present. Potential production ranges from 4,000 pounds per acre in favorable years to 3,000 pounds in unfavorable years. As range condition deteriorates, the switchgrass, sand bluestem, indiangrass, little bluestem, and prairie cordgrass decrease, and saltgrass, blue grama, sand dropseed, sedge, and rush increase. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Seeding with an interseeder is advisable if the range is in poor condition. Sand reedgrass, sand bluestem, sideoats grama, switchgrass, little bluestem, indiangrass, and blue grama are suitable for seeding. Seeding early in spring has proven most successful. Grazing should be light to prevent range deterioration.

Wildlife is an important secondary use of this unit. On the Valent soil, rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

The Loup soil, which is typically wet and produces an abundance of wetland vegetation, attracts wetland wildlife species, such as mallard, teal, geese, and miscellaneous shorebirds. Primary management of this soil for wetland wildlife includes managing livestock grazing, fencing to control livestock, protecting from fire, and preventing drainage. Natural wetland vegetation should be allowed to develop. Capability subclass VIe irrigated, VIe nonirrigated; Valent soil in Choppy Sand Meadow range site, Loup soil in Sandy Meadow range site.

72—Vona loamy sand, 0 to 3 percent slopes. This is a deep, somewhat excessively drained soil on plains and high terraces at elevations of 4,600 to 5,200 feet. It formed in eolian or alluvial deposits. Included in mapping are some leveled areas. Also included are small areas of soils that have a loamy substratum and some areas of soils that are noncalcareous to a depth of 60 inches.

Typically the surface layer of this Vona soil is grayish brown. The upper 6 inches is loamy sand and the lower 6 inches is fine sandy loam. The subsoil is brown and light yellowish brown fine sandy loam about 16 inches thick. The substratum to a depth of 60 inches is sandy loam.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

In irrigated areas this soil is suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 20 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It should be drilled into a clean, firm sorghum stubble or a prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal hazards in establishing trees and shrubs. The soil is so loose that trees should be planted in shallow furrows and vegetation maintained between the rows. Supplemental irrigation is needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can

be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Once established, the lawns, shrubs, and trees grow well. The chief limiting soil feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. In places recreational development is limited by the susceptibility to soil blowing. Capability subclass IIIe irrigated, IVe nonirrigated; Sandy Plains range site.

73—Vona loamy sand, 3 to 5 percent slopes. This is a deep, somewhat excessively drained soil on plains and high terraces at elevations of 4,600 to 5,200 feet. It formed in eolian or alluvial deposits. Included in mapping are some leveled areas. Also included are small areas of soils that have a loamy substratum and some areas of soils that are noncalcareous to a depth of 60 inches.

Typically the surface layer of this Vona soil is grayish brown. The upper 6 inches is loamy sand and the lower 5 inches is fine sandy loam. The subsoil is brown and light yellowish brown fine sandy loam about 14 inches thick. The substratum to a depth of 60 inches is sandy loam.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is suited to limited cropping. Intensive cropping is hazardous because of soil blowing. The cropping system should be limited to such close grown crops as alfalfa, wheat, and barley. The soil is also suited to irrigated pasture. A suitable cropping system is 3 to 4 years of alfalfa followed by 2 years of corn and small grain and alfalfa seeded with a nurse crop.

Closely spaced contour ditches or sprinklers can be used in irrigating close grown crops. Contour furrows or spinklers should be used for new crops. Application of barnyard manure and commercial fertilizer helps to maintain good production.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal hazards in establishing trees and shrubs. The soil is so loose that trees should be planted in shallow furrows and vegetation maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, western redcedar, ponderosa pine, and Siberian elm. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Once established, the lawns, shrubs, and trees grow well. The primary limiting soil feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. In places recreational development is limited by the susceptibility to soil blowing. Capability subclass IVe irrigated, VIe nonirrigated; Sandy Plains range site.

74—Vona loamy sand, 5 to 9 percent slopes. This is a deep, somewhat excessively drained soil on plains at elevations of 4,600 to 5,200 feet. It formed in eolian deposits. Included in mapping are small areas of soils that have a loamy substratum and areas of soils that are noncalcareous to a depth of 60 inches.

Typically the surface layer is grayish brown. The upper 6 inches is loamy sand and the lower 4 inches is fine sandy loam. The subsoil is brown and light yellowish brown fine sandy loam about 12 inches thick. The substratum to a depth of 60 inches is loamy sand.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the principal hazards in establishing trees and shrubs. This soil is so loose that trees should be planted in shallow furrows and vegetation maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Once established, the lawns, shrubs, and trees grow well. The primary limiting soil feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. In places recreational development is limited by the susceptibility to soil blowing. Capability subclass VIe irrigated, VIe nonirrigated; Sandy Plains range site.

75—Vona sandy loam, 0 to 1 percent slopes. This is a deep, well drained soil on high terraces at elevations of 4,650 to 4,950 feet. It formed in alluvial deposits. Included in mapping are some leveled areas and small areas of soils that have a loamy substratum.

Typically the surface layer of this Vona soil is grayish brown sandy loam about 10 inches thick. The subsoil is brown fine sandy loam about 20 inches thick. The substratum to a depth of 60 inches is sandy loam.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa (fig. 7), small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. The rapidly permeable substratum slightly restricts some crops.

All methods of irrigation are suitable, but furrow irrigation is the most common. Proper irrigation management is essential. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be necessary at the time of planting and during the dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. Ring-necked pheasant, mourning dove, and many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture.

This soil has good potential for urban and recreational development. Lawns, shrubs, and trees grow well. The only limiting feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Capability subclass IIs irrigated.

76—Vona sandy loam, 1 to 3 percent slopes. This is a deep, well drained soil on plains and high terraces at elevations of 4,600 to 5,200 feet. It formed in eolian and alluvial deposits. Included in mapping are some leveled areas. Also included are small areas of soils that have a loamy substratum and areas of soils that are noncalcareous to a depth of 60 inches.

Typically the surface layer of this Vona soil is grayish brown sandy loam about 10 inches thick. The subsoil is brown fine sandy loam about 18 inches thick. The substratum to a depth of 60 inches is sandy loam.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines are needed for proper water applications.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be necessary at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The

shrubs best suited are skunkbush sumac, lilac, and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Lawns, shrubs, and trees grow well. The only limiting feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Capability subclass IIe irrigated; IVe nonirrigated; Sandy Plains range site.

77—Vona sandy loam, 3 to 5 percent slopes. This is a deep, well drained soil on plains at elevations of 4,600 to 5,200 feet. It formed in eolian deposits. Included in mapping are small areas of soils that have a loamy substratum and areas of soils that are noncalcareous to a depth of 60 inches.

Typically the surface layer of this Vona soil is grayish brown sandy loam about 8 inches thick. The subsoil is brown fine sandy loam about 15 inches thick. The substratum to a depth of 60 inches is sandy loam.

Permeability is moderately rapid. Available water capacity is moderate. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is low.

In irrigated areas this soil is suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas this soil is suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low to make beneficial use of fertilizer.

Mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation on this range site is dominated by sand bluestem, sand reedgrass, and blue grama. Needleandthread, switchgrass, sideoats grama, and western wheatgrass are also prominent. Potential production ranges from 2,200 pounds per acre in favorable years to 1,800 pounds in unfavorable years. As range condition deteriorates, the sand bluestem, sand reedgrass, and switchgrass decrease and blue grama, sand dropseed, and sand sage increase. Annual weeds and grasses invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if range is in poor condition. Sand bluestem, sand reedgrass, switchgrass, sideoats grama, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings generally are suited to this soil. Soil blowing, the principal hazard in establishing trees and shrubs, can be controlled by cultivating only in the tree row and by leaving a strip of vegetation between the rows. Supplemental irrigation may be needed at the time of planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac and Siberian peashrub.

Wildlife is an important secondary use of this soil. The cropland areas provide favorable habitat for ring-necked pheasant and mourning dove. Many nongame species can be attracted by establishing areas for nesting and escape cover. For pheasants, undisturbed nesting cover is essential and should be included in plans for habitat development, especially in areas of intensive agriculture. Rangeland wildlife, for example, the pronghorn antelope, can be attracted by developing livestock watering facilities, managing livestock grazing, and reseeding where needed.

This soil has good potential for urban and recreational development. Lawns, shrubs, and trees grow well. The only limiting feature is the rapid permeability in the substratum, which causes a hazard of ground water contamination from sewage lagoons. Capability subclass IIIe irrigated, VIe nonirrigated; Sandy Plains range site.

78—Weld loam, 0 to 1 percent slopes. This is a deep, well drained soil on smooth plains at elevations of 4,850 to 5,000 feet. It formed in eolian deposits. Included in mapping are small areas of soils that have a subsoil of loam and light clay loam. Also included are some leveled areas.

Typically the surface layer of this Weld soil is brown loam about 10 inches thick. The subsoil is brown and pale brown heavy clay loam and light clay about 20 inches thick. The substratum to a depth of 60 inches is silt loam.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used almost entirely for irrigated crops. It is suited to all crops commonly grown in the area including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage,

sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings generally are well suited to this soil. Summer fallow a year before planting and continued cultivation for weed control are needed to insure establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to this soil. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation in most years. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife.

This soil has good potential for urban and recreational development. The chief limiting soil features for urban development are the shrink-swell potential of the subsoil as it wets and dries and the limited capacity of the soil to support a load. Lawns, shrubs, and trees grow well. Capability class I irrigated.

79—Weld loam, 1 to 3 percent slopes. This is a deep, well drained soil on smooth plains at elevations of 4,850 to 5,000 feet. It formed in eolian deposits. Included in mapping are small areas of soils that have a subsoil of loam and light clay loam. Also included are some leveled areas.

Typically the surface layer of this Weld soil is brown loam about 8 inches thick. The subsoil is brown and pale brown heavy clay loam and light clay about 20 inches thick. The substratum to a depth of 60 inches is silt loam.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

In irrigated areas this soil is suited to all crops commonly grown in the area, including corn, sugar beets (fig. 8), beans, alfalfa, small grain, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines are needed for proper water applications.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

This soil is well suited to winter wheat, barley, and sorghum if it is summer fallowed in alternate years. Winter wheat is the principal crop. The predicted average yield is 33 bushels per acre. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally well suited to this soil. Summer fallow a year before planting and continued cultivation for weed control are needed to insure establishment and survival of plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to this soil. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife.

This soil has good potential for urban and recreational development. The chief limiting soil features for urban development are the shrink-swell potential of the subsoil as it wets and dries and the limited capacity of the soil to support a load. Lawns, shrubs, and trees grow well. Capability subclass IIe irrigated, IIIc nonirrigated; Loamy Plains range site.

80—Weld loam, 3 to 5 percent slopes. This is a deep, well drained soil on plains at elevations of 4,850 to 5,000 feet. It formed in eolian deposits. Included in mapping are small areas of soils that have a subsoil of loam and light clay loam.

Typically the surface layer is brown loam about 8 inches thick. The subsoil is brown and pale brown heavy clay loam and light clay about 18 inches thick. The substratum to a depth of 60 inches is silt loam.

Permeability is slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

In irrigated areas this soil is suited to most of the crops commonly grown in the area, such as corn, alfalfa, wheat, and barley. Sugar beets are often grown. The soil is suited to irrigated pasture. Ditch lining and installing pipelines are needed for proper water application.

Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Barnyard manure and commercial fertilizer are needed for top yields.

This soil is well suited to winter wheat, barley, and sorghum if it is summer fallowed in alternate years. Winter wheat is the principal crop. The predicted average yield is 28 bushels per acre. If the crop is winterkilled, spring wheat can be seeded. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to this soil. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to this soil. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife.

This soil has good potential for urban and recreational development. The primary limiting soil features for urban development are the shrink-swell potential of the subsoil as it wets and dries and the limited capacity of the soil to support a load. Lawns, shrubs, and trees grow well. Capability subclass IIIe irrigated, IIIe nonirrigated; Loamy Plains range site.

81—Wiley-Colby complex, 0 to 1 percent slopes. This level map unit is on smooth plains at elevations of 4,850 to 5,000 feet. The Wiley soil makes up about 60 percent of the unit, and the Colby soil about 30 percent. About 10 percent is Heldt silty clay and Weld loam.

The Wiley soil is deep and well drained. It formed in calcareous eolian deposits. Typically the surface layer is pale brown silt loam about 11 inches thick. The subsoil is pale brown silty clay loam about 23 inches thick. The substratum to a depth of 60 inches is very pale brown silty clay loam.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

The Colby soil also is deep and well drained and formed in calcareous eolian deposits. Typically the surface layer is pale brown loam about 7 inches thick. The upper 32 inches of the underlying material is very pale brown silt loam. The lower part to a depth of 60 inches is very pale brown silt loam.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is slow, and the erosion hazard is low.

This soil is used for irrigated cropland and wildlife habitat and for urban development.

The soils of this unit are suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, potatoes, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Few conservation practices are needed to maintain top yields.

All methods of irrigation are suitable, but furrow irrigation is most common. Barnyard manure and commercial fertilizer are needed for top yields.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to these soils. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to these soils. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife.

The Wiley soil has only fair potential for urban and recreational development. Slow permeability, moderate shrink-swell potential, and limited bearing capacity cause problems in dwelling and road construction. The Colby soil has good potential for urban and recreational developments. Road design can be modified to compensate for

the limited capacity of this soil to support a load. Capability class I irrigated.

82—**Wiley-Colby complex, 1 to 3 percent slopes.** This nearly level map unit is on smooth plains in the western part of the survey area at elevations of 4,850 to 5,000 feet. The Wiley soil makes up about 60 percent of the unit, and the Colby soil about 30 percent. About 10 percent is Heldt silty clay and Weld loam.

The Wiley soil is deep and well drained. It formed in calcareous eolian deposits. Typically the surface layer is pale brown silt loam about 11 inches thick. The subsoil is pale brown silty clay loam about 23 inches thick. The substratum to a depth of 60 inches is very pale brown silty clay loam.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

The Colby soil also is deep and well drained and formed in calcareous eolian deposits. Typically the surface layer is pale brown loam about 7 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium, and the erosion hazard is moderate.

This map unit is used for irrigated and nonirrigated cropland and for rangeland, wildlife habitat, and urban development.

In irrigated areas these soils are suited to all crops commonly grown in the area, including corn, sugar beets, beans, alfalfa, small grain, and onions. An example of a suitable cropping system is 3 to 4 years of alfalfa followed by corn, corn for silage, sugar beets, small grain, or beans. Land leveling, ditch lining, and installing pipelines may be needed for proper water applications.

All methods of irrigation are suitable, but furrow irrigation is the most common. Barnyard manure and commercial fertilizer are needed for top yields.

In nonirrigated areas these soils are suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses such as western wheatgrass and needleandthread are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on this soil should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings are generally well suited to these soils. Cultivation to control competing vegetation should be continued for as many years as possible following planting. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail are best suited to these soils. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife.

The Wiley soil has only fair potential for urban and recreational development. Slow permeability, moderate shrink-swell potential, and limited bearing capacity cause problems in dwelling and road construction. The Colby soil has good potential for urban and recreational development. Road design can be modified to compensate for the limited capacity of this soil to support a load. Capability subclass IIe irrigated, IVe nonirrigated; Loamy Plains range site.

83—**Wiley-Colby complex, 3 to 5 percent slopes.** This gently sloping map unit is on plains at elevations of 4,850 to 5,000 feet. The Wiley soil makes up about 60 percent of the unit, and the Colby soil about 30 percent. About 10 percent is Heldt silty clay and Weld loam.

The Wiley soil is deep and well drained. It formed in calcareous eolian deposits. Typically the surface layer is pale brown silt loam about 11 inches thick. The subsoil is pale brown silty clay loam about 23 inches thick. The substratum to a depth of 60 inches is very pale brown silty clay loam.

Permeability is moderately slow. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium to rapid, and the erosion hazard is moderate.

The Colby soil also is deep and well drained and formed in calcareous eolian deposits. Typically the surface layer is pale brown loam about 7 inches thick. The underlying material is very pale brown silt loam to a depth of 60 inches.

Permeability is moderate. Available water capacity is high. The effective rooting depth is 60 inches or more. Surface runoff is medium to rapid, and the erosion hazard is moderate.

This unit is used for irrigated and nonirrigated cropland and for rangeland, wildlife habitat, and urban development.

In irrigated areas these soils are suited to the crops commonly grown in the area. Perennial grasses and alfalfa or close grown crops should be grown at least 50 percent of the time. Contour ditches and corrugations can be used in irrigating close grown crops and pasture. Furrows, contour furrows, and cross slope furrows are suitable for row crops. Sprinkler irrigation is also desirable. Keeping tillage to a minimum and utilizing crop residue help to control erosion. Maintaining fertility is important. Crops respond to applications of phosphorus and nitrogen.

In nonirrigated areas these soils are suited to winter wheat, barley, and sorghum. Most of the acreage is planted to winter wheat. The predicted average yield is 28 bushels per acre. The soil is summer fallowed in alternate years to allow moisture accumulation. Generally precipitation is too low for beneficial use of fertilizer.

Stubble mulch farming, stripcropping, and minimum tillage are needed to control soil blowing and water erosion. Terracing also may be needed to control water erosion.

The potential native vegetation is dominated by blue grama. Several mid grasses, such as western wheatgrass and needleandthread, are also present. Potential production ranges from 1,600 pounds per acre in favorable years to 1,000 pounds in unfavorable years. As range condition deteriorates, the mid grasses decrease; blue grama, buffalograss, snakeweed, yucca, and fringed sage increase; and forage production drops. Undesirable weeds and annuals invade the site as range condition becomes poorer.

Management of vegetation on these soils should be based on taking half and leaving half of the total annual production. Seeding is desirable if the range is in poor condition. Sideoats grama, little bluestem, western wheatgrass, blue grama, pubescent wheatgrass, and crested wheatgrass are suitable for seeding. The grass selected should meet the seasonal requirements of livestock. It can be seeded into a clean, firm sorghum stubble, or it can be drilled into a firm prepared seedbed. Seeding early in spring has proven most successful.

Windbreaks and environmental plantings of trees and shrubs commonly grown in the area are generally well suited to these soils. Cultivation to control competing vegetation should be continued for as many years as possible following plantings. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. The shrubs best suited are skunkbush sumac, lilac, Siberian peashrub, and American plum.

Openland wildlife, such as pheasant, mourning dove, and cottontail, are best suited to these soils. Wildlife habitat development, including tree and shrub plantings and grass plantings to serve as nesting areas, should be successful without irrigation during most years. Under irrigation, good wildlife habitat can be established, benefiting many kinds of openland wildlife.

The Wiley soil has only fair potential for urban and recreational development. Slow permeability, moderate shrink-swell potential, and limited bearing capacity cause problems in dwelling and road construction. The Colby soil has good potential for urban and recreational developments. Road design can be modified to compensate for the limited capacity of this soil to support a load. Capability subclass IIIe irrigated, IVe nonirrigated; Loamy Plains range site.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops, pasture, and rangeland, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops and pasture

W. KENT VERVERS, district conservationist, Soil Conservation Service, helped prepare this section.

The major management concerns in the use of the soils for crops and pasture are described in this section. In addition, the crops or pasture plants best suited to the soil, including some not commonly grown in the survey area, are discussed; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are presented for each soil.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

According to the Weld County, Colorado, Land Use Map made in 1973 by the Soil Conservation Service, Greeley, about 480,000 acres in the survey are was irrigated cropland. Of this total about 243,000 acres was in row crops, mainly corn, sugar beets, and dry beans; 86,000 acres in alfalfa hay; 40,000 acres in close grown crops, mainly wheat and barley; and the rest in permanent pasture, nurse crops, and special crops.

The range of precipitation is 11 to 13 inches per year. The length of the growing season is 135 to 150 days.

The potential of the soils in the survey area for increased production of food is good. About 10,000 to 15,000 more acres of suitable cropland could be brought under irrigation by using deep wells. In addition to the reserve productive capacity represented by this acreage, food production could also be increased by extending the latest crop production technology to all cropland in the survey area. This soil survey can greatly facilitate the application of such technology.

The acreage in crops and pasture is gradually decreasing as more land is used for urban and industrial development. The favorable climatic conditions and availability of water are important factors in the population influx of the last 15 years. The use of this soil survey to help make land use decisions that will influence the future role of farming in the county is discussed in the section "Soil Map for General Planning."

Slopes are less than 3 percent on most of the irrigated soils. Slopes of more than 3 percent cause problems in proper irrigation water management. Land leveling (fig. 9), concrete ditch lining, underground pipelines, and concrete structures have been extensively applied over the past quarter century. These improvements have greatly aided the farmer in irrigating his crops.

Along with physical improvements, cultural practices are needed to hold soil and water losses to a minimum. Cropping systems that provide substantial vegetative cover are needed for erosion control where slopes are more than 3 percent. Keeping tillage to a minimum and leaving crop residue on the surface increase infiltration and reduce the hazards of runoff and erosion.

Soil drainage is a major management need on nearly 10 percent of the irrigated land in the soil survey area. Some soils and spots within other soils are so wet that the production of crops is generally not possible. The most poorly drained soils are Aquolls, Aquents, and Aquepts. Other soils that are commonly wet include those just below irrigation canals. Seepage from these canals can cause wet spots to develop over a large acreage. On such soils as Nelson, Renohill, and Thedalund that have sandstone or shale within 20 to 40 inches of the surfae, wet spots develop. Artificial drainage is needed to lower the water table below the root zone.

Artificial drainage is common in the survey area. A recent technological advance is a flexible, perforated plastic pipe that can be mechanically installed underground. The pipe is enveloped with graded pea gravel to screen out fine soil particles that would eventually plug the pipe to make it nonfunctional. Finding suitable, safe, and legal outlets for the water is difficult. On many farms there is not enough slope difference to satisfactorily drain wet areas. In such areas the drainage line is brought to a pit where a pumping system recycles the water to the upper end of the farm for irrigation water.

Information on drainage design for various soils is available at any local Soil Conservation Service office.

Soil fertility is naturally low in the survey area. In all irrigated areas, large amounts of nitrogen are needed for top crop production. Phosphorus also is needed for most crops, but generally less phosphorus than nitrogen is needed. Potash is sometimes needed in certain soils. Zinc and iron are the only other nutrients known to be deficient in many of the soils.

Most irrigation water contains enough calcium, magnesium, and sulfate sulphur to meet the annual requirements of any commonly grown crop. The soil should be tested before any commercial fertilizer is applied.

Soil tilth is important in seed germination and water infiltration. Soils that have good tilth are mellow, crumbly, and easy to work, and they absorb water readily when dry. Soils that have poor tilth are generally hard, cloddy, difficult to work. They run together when wet, and they absorb water slowly. Good soil tilth can be developed and maintained in most areas through the use of good soil management practices. Regular additions of crop residue and manure and the use of deep-rooted, close growing crops such as alfalfa in the cropping system are key factors in maintaining good soil tilth.

Fall plowing is generally not desirable on the lighter textured Bresser, Julesburg, Olney, Otero, and Vona soils. These soils generally dry out and warm up early in spring. Time is adequate, therefore, to prepare the

seedbed just before planting, which eliminates the hazard of soil blowing in winter and early in spring.

The heavier textured Colombo, Heldt, Nunn, Renohill, Ulm, and Wiley soils often benefit from fall plowing. They are generally not subject to blowing if the tillage consists only of plowing and disking. They are subject to more compaction, however, and are often cloddy after plowing. The action of freezing and thawing helps to break up the clods, and a good seedbed can be prepared in spring. Seedbed preparation can be delayed because the soils are often too wet for plowing early in spring.

Field crops best suited to the soils and climate of the survey area are mainly those that are commonly grown. Corn, both for silage and grain, sugar beets, dry beans, and potatoes are the main cultivated crops; alfalfa is the main hay crop. Permanent pasture is generally a mixture of perennial grasses and legumes.

Special crops grown commercially are vegetables and nursery stock. Large acreages of onions, cucumbers for pickles, and carrots are grown in the Greeley area. Some melons are grown in the Kersey area. There are a number of truck farms between Fort Lupton and Brighton where strawberries, asparagus, cabbage, tomatoes, celery, peppers, sweet corn, and other vegetables are grown for the Denver market.

Current information and suggestions for growing special crops can be obtained from local offices of the Colorado State University Extension Service and the Soil Conservation Service.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay and pasture yields were estimated for the most productive varieties of grasses and legumes suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 5.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residues, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown; that good quality irrigation water is uniformly applied in proper amounts as needed; and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area (fig. 10), but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland or for engineering purposes.

In the capability system, all kinds of soil are grouped at two levels: capability class and subclass. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Rangeland

PREPARED BY HARVEY SPROCK, range conervationist, Soil Conservation Service.

About 37 percent of the survey area is range. This range is utilized in several types of ranching, chiefly beef producing ranches. Range is often utilized with farming operations. Aftermath from irrigated cropland and dry cropland provides forage and roughage. Wheat pasture, irrigated pasture and dry pasture also help to balance the grazing programs. Most ranches are cow-calf-yearling enterprises operating on a yearlong grazing program with winter and spring supplemental feeding.

The native vegetation in many parts of the survey area has been greatly depleted by continued excessive use. Much of the acreage that was once open grassland is now covered with brush and weeds. In places the amount of forage produced is less than half of that originally produced. Producitivity of the range can be increased by effective management for specific kinds of soil and range.

Conservation measures which apply to this rangeland are range seeding, fencing, brush control, development of livestock water, proper grazing use, and deferred grazing. Planned grazing systems that periodically defer grazing on each field through the growing season and well-planned structural practices increase the total usable forage.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

The potential annual production of herbage in favorable, normal, and unfavorable years, and the names of major plant species in the potential plant community are shown in the description of each soil map unit on the detailed soil map. The name of the range site is shown at the end of each map unit descripition.

A range site is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community (fig. 11). Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The major range acreage is in the eastern part of the survey area. The soils are mainly deep sand (fig. 12). They support tall grasses. Potential productivity is high because of the rapid permeability and deep rooting depth. There are some areas of hummocks and dunes where soil blowing is a severe hazard. Scattered throughout the survey area are some heavier textured, lower producing range sites.

The major management concern on most of the rangeland is control of grazing so that the kinds and amounts of plants that make up the potential plant community are reestablished. Controlling brush and minimizing soil blowing are also important management concerns. If sound range management based on the soil survey information and rangeland inventories is applied, the potential is good for increasing the productivity of range in the area.

Windbreaks and environmental plantings

SHERMAN J. FINCH, woodland conservationist, Soil Conservation Service, helped prepare this section.

Windbreaks are established to protect livestock, buildings, and yards from wind and snow (fig. 13). Windbreaks also help protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broad-leaved and coniferous species provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field, the interval depending on erodibility of the soil. They protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. A healthy planting stock of suitable species planted properly on a well prepared site and maintained in good condition can insure a high degree of plant survival.

A paragraph in each detailed soil map unit description discusses management of windbreaks and gives a list of suitable trees and shrubs. Additional information about planning windbreaks and screens and the planting and care of trees can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from nurserymen.

Engineering

MILLARD F. DILSAVER, area engineer, Soil Conservation Service, helped prepare this section.

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the

need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 6 shows, for each kind of soil, the degree and kind of limitations for building site development; table 7, for sanitary facilities; and table 9, for water management. Table 8 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 6. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, and open ditches. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 6 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, potential frost action, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 6 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, shrink-swell potential, and potential frost action are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 7 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this

use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 7 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 8 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 12 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 8 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 12.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 9 soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of establishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

ELDIE W. MUSTARD, biologist, Soil Conservation Service, helped prepare this section.

The soils of the survey area are rated in table 10 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility

of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 10 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 7, and interpretations for dwellings without basements and for local roads and streets, given in table 6.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas (fig. 14) are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat

ELDIE W. MUSTARD, biologist, Soil Conservation Service, helped prepare this section.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 11, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture

of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife (fig. 15). Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are mountain-mahogany, bitterbrush, snowberry, and big sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and red fox.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, white pelican, shore birds, muskrat, mink, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include antelope, mule deer, meadowlark, lark bunting, jackrabbit, and coyote.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering properties

Table 12 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 12 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 12 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 12. Also in table 12 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

The estimates in table 12 have been rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone has been omitted.

Physical and chemical properties

Table 13 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 13. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also in-

fluence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar properties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 14 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding,

nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 14 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Potential frost action refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

Classification of the soils

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*5*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 15, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquent (*Aqu*, meaning water, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplaquents (*Hapl*, meaning simple horizons, plus *aquent*, the suborder of Entisols that have an aquic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceeding the name of the great group. The adjective *Typic* identifies the subgroup that is

thought to typify the great group. An example is Typic Haplaquents.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine-loamy, mixed, nonacid, mesic, Typic Haplaquents.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*4*). Unless otherwise noted, colors described are for moist soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Adena series

The Adena series consists of deep, well drained sois that formed in calcareous eolian deposits. Adena soils are on plains. Slopes are 3 to 9 percent.

Adena soils are near Colby and Weld soils. Colby soils lack a B horizon. Weld soils have a dark colored surface layer.

Typical pedon of Adena loam in an area of Colby-Adena loams, 3 to 9 percent slopes, 2,150 feet south and 950 feet west of northeast corner sec. 23, T. 1 N., R. 61 W.

Ap—0 to 6 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate fine granular structure; hard, very friable; neutral; abrupt smooth boundary.

B2t—6 to 9 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; strong medium to fine prismatic structure parting to strong medium to fine angular blocky; very hard, firm; common moderately thick clay films on faces of peds; neutral; clear smooth boundary.

B3ca—9 to 14 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; moderate to weak coarse prismatic structure parting to moderate to weak medium subangular blocky; very hard, friable; few thin clay films on faces of peds; some visible lime in medium soft masses; calcareous; moderately alkaline; gradual irregular boundary.

Cca—14 to 60 inches; very pale brown (10YR 7/3) silt loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; some visible lime in fine filaments or threads; calcareous; moderately alkaline.

Thickness of the solum ranges from 8 to 15 inches. Depth to free carbonates ranges from 5 to 10 inches.

The A horizon has value of 5 or 6 dry and 3 or 4 moist and chroma of 2 or 3. The B2t horizon is commonly clay loam that is 30 to 40 percent clay. The C horizon is commonly silt loam or loam.

Altvan series

The Altvan series consists of deep, well drained soils that formed in material weathered from loamy alluvium underlain by sand and gravel. Altvan soils are on terraces. Slopes are 0 to 3 percent.

Altvan soils are similar to the Ascalon, Dacono, and Nunn soils and are near the Colombo soils. Ascalon and Colombo soils lack a sand and gravel C horizon between 20 and 40 inches. Dacono and Nunn soils average more than 35 percent clay in the B horizon.

Typical pedon of Altvan loam, 0 to 1 percent slopes, 1,850 feet north and 2,450 feet west of southeast corner sec. 27, T. 6 N., R. 67 W.

Ap—0 to 10 inches; grayish brown (10YR 5/2) loam, dark brown (10YR 3/3) moist; weak fine granular structure; hard, friable; 3 percent gravel; calcareous; mildly alkaline; abrupt smooth boundary.

B2t—10 to 20 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to weak medium subangular blocky; very hard, firm; few thin clay films on faces of peds; 3 percent gravel; noncalcareous; mildly alkaline; abrupt wavy boundary.

B3ca—20 to 25 inches; light yellowish brown (10YR 6/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic structure; hard, friable; very few thin clay films on faces of peds; 2 percent gravel; some visible lime in fine seams and threads; calcareous; moderately alkaline; clear smooth boundary.

C1—25 to 31 inches; pale brown (10YR 6/3) loamy sand, grayish brown (10YR 5/2) moist; massive; slightly hard, very friable; 10 percent gravel; calcareous; moderately alkaline; clear smooth boundary.

IIC2—31 to 60 inches; pale brown (10YR 6/3) gravelly sand, brown (10YR 5/3) moist; single grained; loose; 30 percent gravel; calcareous; mildly alkaline.

Thickness of the solum ranges from 16 to 28 inches. Coarse fragments make up less than 10 percent of the solum. Depth to free carbonates ranges from 16 to 24 inches. Depth to contrasting material ranges 20 to 40 inches.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 2 or 3. The B2t horizon is commonly clay loam or sandy clay loam that is 20 to 35 percent clay.

Ascalon series

The Ascalon series consists of deep, well drained soils that formed in alluvium. Ascalon soils are on upland hills and old terraces. Slopes are 0 to 9 percent.

Ascalon soils are similar to the Altvan and Nunn soils and are near the Olney and Vona soils. Altvan soils have

a sand and gravel C horizon between 20 and 40 inches. Nunn soils are more than 35 percent clay in the B horizon. Olney and Vona soils have a light colored surface layer.

Typical pedon of Ascalon sandy loam, 5 to 9 percent slopes, 900 feet south and 1,800 feet west of northeast corner sec. 32, T. 1 N., R. 61 W.

Ap—0 to 8 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

B21t—8 to 14 inches; yellowish brown (10YR 5/4) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to strong medium subangular blocky; hard, firm; common thin clay films on faces of peds; neutral; clear smooth boundary.

B22t—14 to 18 inches; pale brown (10YR 6/3) sandy clay loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm; few thin clay films on faces of peds; neutral; gradual smooth boundary.

B3ca—18 to 22 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm; very few thin clay films on faces of some peds; some visible lime in fine seams and threads; calcareous; moderately alkaline; gradual wavy boundary.

Cca—22 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; some visible lime in fine seams and threads; calcareous; moderately alkaline.

Thickness of the solum ranges from 15 to 39 inches. Coarse fragments make up less than 10 percent of the solum. Depth to free carbonates ranges from 10 to 25 inches.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 2 or 3. It is sandy loam or loam. The B2t horizon is commonly sandy clay loam that is 20 to 35 percent clay.

Bankard series

The Bankard series consists of deep, well drained to excessively drained soils that formed in stratified sandy alluvium. Bankard soils are on bottom lands. Slopes are 0 to 3 percent.

Bankard soils are similar to the Haverson soils and are near the Aquolls and Aquents. Haverson soils are finer textured in the C horizon. Aquolls and Aquents are poorly drained.

Typical pedon of Bankard sandy loam, 0 to 3 percent slopes, 550 feet north and 2,300 feet west of the southeast corner sec. 30, T. 5 N., R. 65 W.

A1—0 to 4 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak fine granular structure; soft, very friable; calcareous; moderately alkaline; gradual, wavy boundary.

C—4 to 60 inches; pale brown (10YR 6/3) sand stratified with thin lenses of loam, sandy loam, and fine gravel, brown (10YR 5/3) moist; single grained; loose; calcareous; moderately alkaline.

Typically these soils have free carbonates at the surface. Coarse fragments make up 0 to 10 percent of the soil.

The A horizon has value of 5 or 6 dry and to 5 moist and chroma of 2 or 3 . It is sandy loam or loamy sand. The C horizon is commonly sand or loamy sand.

Boel series

The Boel series consists of deep, somewhat poorly drained soils that formed in stratified sandy alluvium. Boel soils are mainly along Lost Creek in the sandhill area. Slopes are 0 to 3 percent.

Boel soils are near the Loup and Valent soils. Loup soils are poorly drained and are mottled at the surface. Valent soils are excessively drained and have a light colored surface layer.

Typical pedon of Boel loamy sand in an area of Loup-Boel loamy sands, 0 to 3 percent slopes, 100 feet north and 500 feet west of the southeast corner sec. 35, T. 3 N., R. 63 W.

A1—0 to 14 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, loose; calcareous; moderately alkaline; gradual smooth boundary.

C1—14 to 31 inches; pale brown (10YR 6/3) loamy sand stratified with thin lenses of sandy loam, brown (10YR 5/3) moist; few fine faint light yellowish brown (10YR 6/4) moist and yellowish brown (10YR 5/6) moist mottles; massive; soft, very friable; calcareous; moderately alkaline; diffuse wavy boundary.

C2—31 to 60 inches; very pale brown (10YR 7/3) loamy sand stratified with thin lenses of sandy loam and sand, pale brown (10YR 6/3) moist; common medium distinct yellowish brown (10YR 5/8) moist, brownish yellow (10YR 6/6) moist, and gray (10YR 5/1) moist mottles; massive; soft, very friable; calcareous; moderately alkaline.

Typically these soils have free carbonates at the surface. The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 1 or 2. The C horizon has value of 6 or 7 dry and 5 or 6 moist and chroma of 2 or 3. It is loamy sand or sand.

Bresser series

The Bresser series consists of deep, well drained soils that formed in alluvium. Bresser soils are on terraces. Slopes are 0 to 3 percent.

Bresser soils are similar to Ascalon and Julesburg soils and are near the Olney, Otero, and Vona soils. Ascalon soils have free carbonates in some horizons above a depth of 40 inches. Julesburg soils are less than 18 percent clay in the B horizon. Olney, Otero, and Vona soils have a light colored surface layer.

Typical pedon of Bresser sandy loam, 0 to 1 percent slopes, 120 feet north and 1,320 feet east of the southwest corner sec. 27, T. 4 N., R. 66 W.

Ap—0 to 11 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; hard, very friable; neutral; abrupt smooth boundary.

B1—11 to 16 inches; brown (10YR 5/3) sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; hard, very friable; few thin clay films on some faces of peds; neutral; clear smooth boundary.

B2t—16 to 25 inches; yellowish brown (10YR 5/4) sandy clay loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to weak medium subangular blocky; very hard, friable; few thin clay films on faces of peds; neutral; clear smooth boundary.

B3—25 to 30 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; moderate coarse subangular blocky structure; very hard, friable; neutral; clear smooth boundary.

C—30 to 60 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; massive; soft, loose; neutral.

Thickness of the solum ranges from 20 to 37 inches. Coarse fragments make up 0 to 10 percent of the solum. Depth to free carbonates is more than 40 inches.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 2 or 3. The B2t horizon is commonly sandy clay loam that is 20 to 30 percent clay. The C horizon ranges from coarse sandy loam to loamy sand.

Cascajo series

The Cascajo series consists of deep, excessively drained soils that formed in very gravelly alluvium. Cascajo soils are on upland ridges and knobs. Slopes are 5 to 20 percent.

Cascajo soils are near the Ascalon, Olney, Otero, and Vona soils. Ascalon, Olney, and Vona soils have a B horizon and lack gravelly horizons. Otero soils lack calcic horizons.

Typical pedon of Cascajo gravelly sandy loam, 5 to 20 percent slopes, in the southeast corner sec. 27, T. 5 N., R. 64 W.

A1—0 to 9 inches; brown (10YR 5/3) gravelly sandy loam, brown (10YR 4/3) moist; weak fine granular structure; slightly hard, friable; 5 percent cobbles, 28 percent gravel; calcareous; moderately alkaline; clear wavy boundary.

C1ca—9 to 21 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; 10 percent cobbles, 50 percent gravel; some visible lime occuring in large soft masses and as coatings on the undersides of gravel and cobbles; calcareous; moderately alkaline; gradual wavy boundary.

C2ca—21 to 31 inches; light yellowish brown (10YR 6/4) extremely gravelly sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; 5 percent cobbles, 70 percent gravel; some visible lime occuring in large soft masses and as coatings on the undersides of gravel and cobbles; calcareous; moderately alkaline; gradual wavy boundary.

C3—31 to 60 inches; light yellowish brown (10YR 6/4) very gravelly sand, yellowish brown (10YR 5/4) moist; single grained; loose; 50 percent gravel; calcareous; mildly alkaline.

Typically these soils have free carbonates at the surface. Content of coarse fragments ranges from 20 to 70 percent, and as many as 10 percent are larger than 3 inches.

The A horizon has value of 4 to 6 dry and 4 or 5 moist and chroma of 2 or 3. The C horizon is dominantly very gravelly sandy loam but ranges to very gravelly sand. The sandier texture occurs below 30 inches.

Colby series

The Colby series consists of deep, well drained soils that formed in calcareous eolian deposits. Colby soils are on plains, hills, and ridges. Slopes are 0 to 9 percent.

Colby soils are similar to the Kim and Otero soils and are near the Adena, Weld, and Wiley soils. Kim and Otero soils are less silty in all horizons. Adena, Weld, and Wiley soils have a B horizon.

Typical pedon of Colby loam, 5 to 9 percent slopes, 300 feet south and 650 feet west of northeast corner sec. 23, T. 1 N., R. 61 W.

Ap—0 to 7 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; moderate fine granular structure; soft, very friable; calcareous; moderately alkaline; abrupt smooth boundary.

C1—7 to 22 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse to medium subangular blocky structure; hard, friable; calcareous; moderately alkaline; clear smooth boundary.

C2—22 to 39 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, friable; calcareous; moderately alkaline; clear smooth boundary.

C3—39 to 60 inches; very pale brown (10YR 7/4) silt loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

Typically these soils have free carbonates at the surface. The A horizon has value of 5 to 7 dry and 3 to 5 moist and chroma of 2 or 3. The C horizon is commonly silt loam or loam. A Ca horizon is present in places.

Colombo series

The Colombo series consists of deep, well drained soils that formed in stratified recent alluvium. Colombo soils are on terraces and flood plains. Slopes are 0 to 3 percent.

Colombo soils are near the Haverson and Nunn soils. Haverson soils have a light colored surface layer. Nunn soils have a B horizon.

Typical pedon of Colombo clay loam, 1 to 3 percent slopes, 2,350 feet north and 200 feet east of southwest corner sec. 4, T. 5 N., R. 64 W.

Ap—0 to 14 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; calcareous moderately alkaline; clear smooth boundary.

C1—14 to 21 inches; pale brown (10YR 6/3) stratified clay loam and loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure grading to massive; slightly hard, friable; calcareous; moderately alkaline; gradual smooth boundary.

C2—21 to 60 inches; very pale brown (10YR 7/3) loam stratified with thin lenses of fine sand, medium sand, and clay loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; calcareous; moderately alkaline.

Typically these soils have free carbonates at the surface. Coarse fragments make up as much as 15 percent of the soil.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 1 to 3. The C horizon is commonly loam stratified with thin lenses of sand and clay loam.

Dacono series

The Dacono series consists of deep, well drained soils that formed in mixed alluvium underlain by sand and gravel. Dacono soils are on terraces. Slopes are 0 to 3 percent.

Dacono soils are similar to the Altvan and Nunn soils and are near the Colombo and Haverson soils. Altvan soils are less than 35 percent clay in the B horizon. Colombo and Haverson soils lack a Bt horizon. Nunn soils lack a sand and gravel C horizon between 20 and 40 inches.

Typical pedon of Dacono clay loam, 0 to 1 percent slopes, 910 feet south and 1,080 feet west of northeast corner sec. 1, T. 7 N., R. 66 W.

Ap—0 to 12 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, firm; neutral; clear smooth boundary.

B2t—12 to 21 inches; grayish brown (10YR 5/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; moderate fine prismatic structure

parting to moderate fine angular blocky; extremely hard, very firm; common moderate thick clay films on faces of peds; noncalcareous; mildly alkaline; clear smooth boundary.

B3ca—21 to 27 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure; extremely hard, very firm; few thin clay films on faces of peds; 10 percent gravel; some visible lime occuring in fine soft masses; calcareous; mildly alkaline; clear wavy boundary.

IIC—27 to 60 inches; pale brown (10YR 6/3) very gravelly sand, brown (10YR 5/3) moist; single grained; loose; 50 percent gravel; calcareous; mildly alkaline.

Thickness of the solum ranges from 16 to 40 inches. Coarse fragments make up less than 10 percent of the solum. Depth to contrasting material ranges from 22 to 34 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. The B2t horizon is commonly heavy clay loam that is 35 to 40 percent clay.

Fort Collins series

The Fort Collins series consists of deep, well drained soils that formed in alluvium. Fort Collins soils are on smooth plains and high terraces. Slopes are 0 to 3 percent.

Fort Collins soils are similar to the Olney soils and are near the Kim and Nunn soils. Olney soils are more than 35 percent fine and coarser sand in the B and C horizons. Kim soils lack a B horizon. Nunn soils are more than 35 percent clay in the B2t horizon.

Typical pedon of Fort Collins loam, 1 to 3 percent slopes, 2,510 feet south and 1,500 feet west of northeast corner sec. 17, T. 6 N., R. 66 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak medium granular structure; slightly hard, friable; noncalcareous; mildly alkaline; abrupt smooth boundary.

B2t—7 to 11 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate to weak medium subangular blocky; hard, firm; common thin clay films on faces of peds; noncalcareous; mildly alkaline; clear smooth boundary.

B3ca—11 to 24 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; weak coarse prismatic structure; slightly hard, friable; few thin clay films on some faces of peds; some visible lime in fine filaments or threads; calcareous; moderately alkaline; gradual wavy boundary.

Cca—24 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; soft, friable; some visible lime occuring as medium seams; calcareous; moderately alkaline.

Thickness of the solum ranges from 18 to 30 inches. Coarse fragments make up 0 to 5 percent of the solum. Depth to free carbonates ranges from 8 to 20 inches.

The A horizon has value of 5 or 6 dry and 4 or 5 moist and chroma of 2 or 3. The B2t horizon is commonly clay loam that is 28 to 35 percent clay.

Haverson series

The Haverson series consists of deep, well drained soils that formed in stratified recent loamy alluvium. Haverson soils are on low terraces and flood plains. Slopes are 0 to 3 percent.

Haverson soils are similar to the Bankard soils and are near the Colombo and Nunn soils. Bankard soils are sandy in the C horizon. Colombo and Nunn soils have a dark colored surface layer.

Typical pedon of Haverson loam, 1 to 3 percent slopes, 880 feet south and 1,140 feet west of northeast corner sec. 29, T. 2 N., R. 61 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; neutral; clear smooth boundary.

C1—4 to 25 inches; pale brown (10YR 6/3) loam stratified with thin lenses of loamy sand and clay loam, dark grayish brown (10YR 4/2) moist; moderate fine platy structure; slightly hard, very friable; calcareous; mildly alkaline; gradual wavy boundary.

C2—25 to 60 inches; pale brown (10YR 6/3) loam, dark grayish brown (10YR 4/2) moist; massive; soft, very friable; calcareous; moderately alkaline.

Coarse fragments make up 0 to 5 percent of the soil. The A horizon has value of 5 or 6 dry and 4 or 5 moist and chroma of 2 or 3. The C horizon is commonly loam stratified with thin lenses of loamy sand to clay loam.

Heldt series

The Heldt series consists of deep, moderately well drained soils that formed in alluvial sediment derived from shale. Heldt soils are on plains. Slopes are 1 to 5 percent.

Heldt soils are near the Colby, Ulm, Weld, and Wiley soils. Colby soils lack a B horizon. Ulm, Weld, and Wiley soils have a B2t horizon.

Typical pedon of Heldt silty clay, 1 to 3 percent slopes, 270 feet north and 2,785 feet west of southeast corner sec. 32, T. 3 N., R. 68 W.

Ap—0 to 4 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; strong fine granular structure; slightly hard, friable; calcareous; moderately alkaline; abrupt smooth boundary.

A12—4 to 7 inches; light yellowish brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) moist; massive; extremely hard, very firm; calcareous; moderately alkaline; clear smooth boundary.

B2—7 to 25 inches; light brownish gray (2.5Y 6/2) silty clay, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate fine angular blocky; extremely hard, very firm; common shiny slickensides; calcareous; moderately alkaline; clear wavy boundary.

B3ca—25 to 34 inches; light brownish gray (2.5Y 6/2) silty clay, light olive brown (2.5Y 5/4) moist; weak medium prismatic structure parting to moderate to weak fine angular blocky; extremely hard, very firm; some visible lime in fine filaments or threads; calcareous; strongly alkaline; gradual smooth boundary.

C—34 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, light olive brown (2.5Y 5/4) moist; weak medium subangular blocky structure; extremely hard, very firm; calcareous; strongly alkaline.

Thickness of the solum ranges from 21 to 48 inches. Typically these soils have free carbonates at the surface. Cracks 1/2 inch or more wide usually appear when the soil is dry.

The A horizon has hue of 10YR or 2.5Y and value of 6 or 7 dry and 4 to 6 moist. The B2 horizon is commonly silty clay that is 40 to 50 percent clay.

Julesburg series

The Julesburg series consists of deep, well drained soils that formed in alluvium. Julesburg soils are on terraces. Slopes are 0 to 3 percent.

Julesburg soils are similar to the Bresser soils and are near the Olney, Otero, and Vona soils. Bresser soils are more than 18 percent clay in the B horizon. Olney, Otero, and Vona soils have a light colored surface layer.

Typical pedon of Julesburg sandy loam, 1 to 3 percent slopes, 125 feet south and 700 feet west of northeast corner sec. 25, T. 4 N., R. 66 W.

Ap—0 to 12 inches; brown (10YR 5/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

B2t—12 to 23 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure; extremely hard, friable; few thin clay films on faces of peds; noncalcareous; mildly alkaline; clear smooth boundary.

B3—23 to 27 inches; pale brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; very hard, very friable; oriented clay occurs as bridges between and as coatings on some sand grains; neutral; clear smooth boundary.

C1—27 to 38 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; massive; soft, very friable; neutral; gradual smooth boundary.

C2—38 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; single grained; loose; neutral.

Thickness of the solum ranges from 24 to 38 inches. Coarse fragments make up 0 to 10 percent of the solum. Depth to free carbonates is more than 50 inches.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 2 or 3. The B2t horizon is commonly sandy loam that is 10 to 18 percent clay. The C horizon is sand or loamy sand.

Kim series

The Kim series consists of deep, well drained soils that formed in mixed eolian deposits and parent sediment from a wide variety of bedrock. Kim soils are on plains and alluvial fans. Slopes are 0 to 9 percent.

Kim soils are similar to the Colby, Otero, Shingle, and Thedalund soils and are near the Fort Collins and Olney soils. Colby soils are more silty in all horizons. Otero soils are less than 18 percent clay in the C horizon. Shingle and Thedalund soils have shale between 10 and 40 inches. Fort Collins and Olney soils have a B horizon.

Typical pedon of Kim loam, 1 to 3 percent slopes, 270 feet south and 366 feet west of northeast corner sec. 15, T. 6 N., R. 66 W.

Ap—0 to 7 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak fine granular structure; slightly hard, very friable; calcareous; moderately alkaline; clear smooth boundary.

A12—7 to 12 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak fine granular structure; slightly hard, very friable; calcareous; moderately alkaline; clear smooth boundary.

C1—12 to 18 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; hard, friable; calcareous; moderately alkaline; clear smooth boundary.

C2—18 to 40 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; slightly hard, friable; calcareous; moderately alkaline; clear smooth boundary.

C3—40 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; soft, very friable; calcareous; moderately alkaline.

Typically these soils have free carbonates at the surface. content of coarse fragments ranges to as much as 10 percent.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 4. The control section is loam or light clay loam that is 18 to 30 percent clay.

Loup series

The Loup series consists of deep, poorly drained soils that formed in sandy alluvium. Loup soils are mostly along Lost Creek in the sandhill area. Slopes are 0 to 3 percent.

Loup soils are near the Boel and Valent soils. Boel soils are stratified and somewhat poorly drained. Valent soils are excessively drained and have a light colored surface layer.

Typical profile of Loup loamy sand in an area of Loup-Boel loamy sands, 0 to 3 percent slopes, 850 feet west and 650 feet south of northeast corner sec. 31, T. 3 N., R. 62 W.

O1—2 inches to 0; undecomposed organic material, chiefly grasses, sedges, and roots.

A1—0 to 16 inches; very dark grayish brown (10YR 3/2) loamy sand with few fine distinct reddish brown (5YR 5/4) and dark gray (N 4/0) mottles, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; calcareous; moderately alkaline; diffuse boundary.

C1—16 to 40 inches; light brownish gray (10YR 6/2) loamy sand with few fine distinct yellowish brown (10YR 4/4) mottles, grayish brown (10YR 5/2) moist; weak fine granular structure; soft, very friable; calcareous; moderately alkaline; gradual wavy boundary.

C2—40 to 60 inches; light brownish gray (10YR 6/2) sandy loam with common medium distinct yellowish brown (10YR 5/6) and gray (10YR 5/1) mottles, grayish brown (10YR 5/2) moist; massive; hard, friable; calcareous; moderately alkaline.

Typically these soils have free carbonates at the surface. The A horizon has value of 3 or 4 dry and 2 or 3 moist and chroma of 1 or 2. The C horizon, to a depth of 40 inches or more, is loamy sand or sand.

Midway series

The Midway series consists of shallow, well drained soils that formed in residuum from calcareous shale. Midway soils are on upland hills and ridges. Slopes are 5 to 20 percent.

Midway soils are similar to the Shingle, Tassel, and Thedalund soils and are near the Renohill and Ulm soils. Shingle and Tassel soils are less than 35 percent clay in the C horizon. Thedalund soils are moderately deep. Renohill and Ulm soils have a B horizon.

Typical profile of Midway clay in an area of Midway-Shingle complex, 5 to 20 percent slopes, 350 feet south and 350 feet east of northwest corner sec. 32, T. 1 N., R. 68 W.

Ap—0 to 7 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; weak medium granular structure; extremely hard, very firm; calcareous; moderately alkaline; clear smooth boundary.

C1—7 to 13 inches; light brownish gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, extremely firm; 30

percent weathered shale chips; calcareous; moderately alkaline; gradual wavy boundary.
C2r—13 inches; calcareous clayey shale.

Typically these soils have free carbonates at the surface. Depth to shale ranges from 10 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 or 4. The C horizon has hue of 10YR or 2.5Y. It is commonly clay that is 40 to 45 percent clay.

Nelson series

The Nelson series consists of moderately deep, well drained soils that formed in residuum from soft calcareous sandstone. Nelson soils are on plains. Slopes are 0 to 9 percent.

Nelson soils are similar to Kim, Otero, Tassel, and Thedalund soils and are near the Olney soils. Kim, Otero and Olney soils are deep. Tassel soils have sandstone between 10 and 20 inches. Thedalund soils are more than 18 percent clay in the C horizon.

Typical pedon of Nelson fine sandy loam, 0 to 3 percent slopes, 2,000 feet south and 2,450 feet east of northwest corner sec. 17, T. 6 N., R. 66 W.

Ap—0 to 9 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure parting to moderate fine granular; slightly hard, very friable; calcareous; moderately alkaline; abrupt smooth boundary.
C1ca—9 to 30 inches; light olive brown (2.5Y 5/4) fine sandy loam, olive brown (2.5Y 4/4) moist; massive; hard, very friable; some visible lime occuring as concretions and in fine seams and filaments; calcareous; moderately alkaline; gradual wavy boundary.
C2r—30 inches; soft calcareous sandstone.

Typically these soils have free carbonates at the surface. Depth to soft sandstone ranges from 20 to 40 inches. Content of rock fragments ranges from 0 to 10 percent.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 3 or 4 moist, and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y. It is fine sandy loam or sandy loam.

Nunn series

The Nunn series consists of deep, well drained soils that formed in mixed alluvium and eolian deposits. Nunn soils are on terraces, alluvial fans, and smooth plains. Slopes are 0 to 3 percent.

Nunn soils are similar to the Altvan and Dacono soils and are near the Colombo, Fort Collins, Haverson, and Weld soils. Altvan and Dacono soils have a sand and gravel C horizon at a depth of 20 to 40 inches. Colombo and Haverson soils lack a B horizon. Fort Collins soils are less than 35 percent clay in the B horizon. Weld soils have an abrupt textural boundary between the A and B horizons.

Typical pedon of Nunn clay loam, 0 to 1 percent slopes, 400 feet north and 1,040 feet east of southwest corner sec. 22, T. 6 N., R. 66 W.

Ap—0 to 9 inches; grayish brown (10YR 5/2) clay loam; very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; noncalcareous; mildly alkaline; clear smooth boundary.
B2t—9 to 19 inches; light brownish gray (10YR 6/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; very hard, firm; common moderately thick clay films on faces of peds; noncalcareous; mildly alkaline; clear wavy boundary.
B3—19 to 23 inches; light brownish gray (10YR 6/2) heavy clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to weak fine subangular blocky; hard, friable; calcareous; mildly alkaline; clear wavy boundary.
C1ca—23 to 29 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; some visible lime in fine seams and filaments; calcareous; moderately alkaline; clear wavy boundary.
C2ca—29 to 60 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; soft, very friable; some visible lime in fine filaments; calcareous; moderately alkaline.

Thickness of the solum ranges from 17 to 33 inches. Coarse fragments make up as much as 10 percent of the solum. Depth to free carbonates ranges from 12 to 25 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 2 or 3. It is clay loam, loam, or loamy sand. The B2t horizon is commonly heavy clay loam that is 35 to 40 percent clay.

Olney series

The Olney series consists of deep, well drained soils that formed in alluvium. Olney soils are on plains. Slopes are 0 to 5 percent.

Olney soils are similar to the Fort Collins and Vona soils and are near the Kim, Nelson, Otero, and Thedalund soils. Fort Collins soils are less than 35 percent fine and coarser sand in the B horizon. Vona soils are less than 18 percent clay in the B horizon. Nelson and Thedalund soils have sandstone and shale between 20 and 40 inches.

Typical pedon of Olney fine sandy loam, 0 to 1 percent slopes, 1,320 feet north and 284 feet east of southwest corner sec. 28, T. 6 N., R. 66 W.

Ap—0 to 10 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable; noncalcareous; mildly alkaline; abrupt smooth boundary.
B2t—10 to 20 inches; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium prismatic structure parting to moderate fine subangular blocky; hard, friable; common moderately thick clay films on faces of peds; noncalcareous; mildly alkaline; clear wavy boundary.
B3ca—20 to 25 inches; very pale brown (10YR 7/3) sandy clay loam, brown (10YR 5/3) moist; moderate coarse prismatic structure; slightly hard, very friable; some visible lime occuring in fine to medium seams and soft masses; calcareous; moderately alkaline; gradual smooth boundary.
Cca—25 to 60 inches; very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) moist; weak coarse subangular blocky structure; slightly hard, very friable; some visible lime in fine to medium threads and seams; calcareous; moderately alkaline.

Thickness of the solum ranges from 17 to 30 inches. Coarse fragments make up as much as 15 percent of the solum. Depth to free carbonates ranges from 10 to 24 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 or 3. It is fine sandy loam or loamy sand. The B2t horizon is commonly sandy clay loam, but clay content ranges from 18 to 30 percent.

Osgood series

The Osgood series consists of deep, well drained soils that formed in eolian sands. Osgood soils are on smooth plains. Slopes are 0 to 3 percent.

Osgood soils are near the Valent and Vona soils. Valent soils lack a B horizon. Vona soils have an A horizon that is less than 20 inches thick.

Typical pedon of Osgood sand, 0 to 3 percent slopes, 1,400 feet east and 500 feet north of southwest corner sec. 13, T. 4 N., R. 63 W.

A11—0 to 10 inches; grayish brown (10YR 5/2) sand, dark grayish brown (10YR 4/2) moist; single grained; loose; neutral; gradual smooth boundary.

A12—10 to 22 inches; brown (10YR 5/3) sand, dark brown (10YR 4/3) moist; single grained; loose; neutral; clear smooth boundary.

B21t—22 to 28 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable; very few thin clay films on faces of some peds; neutral; clear smooth boundary.

B22t—28 to 34 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm; very few thin clay films on faces of peds; neutral; clear wavy boundary.

C1ca—34 to 42 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; massive; slightly hard, very friable; some visible lime occuring in fine threads and soft masses; calcareous; moderately alkaline; gradual wavy boundary.

C2—42 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; single grained; soft, loose; calcareous; moderately alkaline.

Thickness of the A horizon ranges from 21 to 30 inches. The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 4 or 5 moist and chroma of 2 or 3. The B2t horizon is commonly sandy loam, but the clay content of the B2t horizon ranges from 15 to 30 percent.

Otero series

The Otero series consists of deep, well drained soils that formed in alluvium and eolian deposits. Otero soils are on plains and terraces. Slopes are 0 to 9 percent.

Otero soils are similar to the Kim, Nelson, Tassel, and Thedalund soils and are near the Olney and Vona soils. Kim soils are more than 18 percent clay in the C horizon. Nelson, Tassel, and Thedalund soils have sandstone and shale between 10 and 40 inches. Olney and Vona soils have a B horizon.

Typical pedon of Otero sandy loam, 1 to 3 percent slopes, 950 feet north and 2,400 feet west of southeast corner sec. 24, T. 6 N., R. 66 W.

Ap—0 to 12 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; moderate fine granular structure; slightly hard, very friable; calcareous; mildly alkaline; abrupt smooth boundary.

C1ca—12 to 22 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, friable; some visible lime occuring in medium soft masses; calcareous; moderately alkaline; gradual smooth boundary.

C2—22 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; hard, friable; calcareous; moderately alkaline.

Typically these soils have free carbonates at the surface. Content of coarse fragments ranges from 0 to 10 percent.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 to 4. The C horizon is commonly sandy loam or fine sandy loam that is less than 18 percent clay.

Paoli series

The Paoli series consists of deep, well drained soils that formed in calcareous alluvium. Paoli soils are on terraces. Slopes are 0 to 3 percent.

Paoli soils are near the Altvan, Ascalon, and Otero soils. Altvan and Ascalon soils have a B horizon. Otero soils have a light colored surface horizon.

Typical pedon of Paoli loam, 0 to 1 percent slopes, 750 feet north and 200 feet east of southwest corner sec. 19, T. 4 N., R. 68 W.

Ap—0 to 10 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

A12—10 to 20 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky parting to moderate medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

A13— 20 to 25 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure; slightly hard, very friable; calcareous; mildly alkaline; clear smooth boundary.

C1ca—25 to 40 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; slightly hard, very friable; some visible lime in fine threads and seams; calcareous; moderately alkaline; gradual smooth boundary.

C2ca—40 to 60 inches; light brownish gray (10YR 6/2) fine sandy loam with few seams of sandy loam and loam, dark graysh brown (10YR 4/2) moist; massive; slightly hard, very friable; some visible lime in fine threads and seams; calcareous; moderately alkaline.

Thickness of the dark colored A horizon ranges from 20 to 50 inches. Rock fragments make up 0 to 15 percent of the soil.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5 dry and 2 or 3 moist, and chroma of 1 to 3. Texture between 10 and 40 inches is commonly fine sandy loam that is 5 to 18 percent clay.

Renohill series

The Renohill series consists of moderately deep, well drained soils that formed in residuum from calcareous shale. Renohill soils are on plains. Slopes are 0 to 9 percent.

Renohill soils are similar to the Olney and Ulm soils and are near the Midway, Shingle, and Thedalund soils. Olney and Ulm soils are deep. Midway, Shingle, and Thedalund soils lack a B horizon.

Typical pedon of Renohill clay loam, 0 to 3 percent slopes, 270 feet south and 1,400 feet west of northeast corner sec. 30, T. 8 N., R. 65 W.

Ap—0 to 9 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable; neutral; clear smooth boundary.

B2t—9 to 16 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prisms parting to moderate fine subangular blocky structure; very hard, firm; common moderately thick clay films on faces of peds; noncalcareous; mildly alkaline; clear wavy boundary.

B3ca—16 to 23 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse prisms parting to weak medium subangular blocky structure; hard, friable; few thin clay films on faces of peds; some visible lime occuring in fine soft masses; calcareous; moderately alkaline; clear wavy boundary.

C1ca—23 to 32 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; slightly hard, friable; some visible lime occuring in fine soft masses; calcareous; moderately alkaline; gradual smooth boundary.

C2r—32 inches; calcareous shale.

Thickness of the solum ranges from 17 to 30 inches. Depth to free carbonates ranges from 6 to 20 inches. Depth to shale ranges from 20 to 40 inches. Coarse fragments make up 0 to 10 percent of the soil.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 or 3. The B2t horizon has hue of 10YR or 2.5Y. It is commonly heavy clay loam or light clay that is 35 to 45 percent clay.

Shingle series

The Shingle series consists of shallow, well drained soils that formed in residuum from calcareous shale. Shingle soils are on upland hills and ridges. Slopes are 1 to 9 percent.

Shingle soils are similar to the Midway, Tassel, and Thedalund soils and are near the Renohill and Ulm soils. Midway soils are more than 35 percent clay in the C horizon. Tassel soils are less than 18 percent clay in the C horizon. Thedalund soils are moderately deep. Renohill and Ulm soils have a B horizon.

Typical pedon of Shingle loam, 1 to 3 percent slopes, 1,100 feet south and 950 feet west of northeast corner sec. 36, T. 7 N., R. 65 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; hard, friable; calcareous; moderately alkaline; clear smooth boundary.

AC—6 to 11 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; weak medium subangular blocky structure; slightly hard, friable; some visible lime occuring in fine soft masses; calcareous; moderately alkaline; clear smooth boundary.

C1—11 to 18 inches; light yellowish brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; very hard, firm; some visible lime occuring in medium soft masses; calcareous; moderately alkaline; clear wavy boundary.

C2r—18 inches; variegated calcareous clayey shale.

Typically these soils have free carbonates at the surface. Depth to shale ranges from 10 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 to 4. The C horizon has hue of 10YR or 2.5Y. The control section is 18 to 35 percent clay.

Tassel series

The Tassel series consists of shallow, well drained soils that formed in residuum from calcareous sandstone. Tassel soils are on upland breaks. Slopes are 5 to 20 percent.

Tassel soils are similar to Otero, Shingle, and Thedalund soils and are near the Terry soils. Otero soils are deep. Shingle soils are more than 18 percent clay in the C horizon. Thedalund and Terry soils have shale or sandstone between 20 and 40 inches.

Typical pedon of Tassel fine sandy loam, 5 to 20 percent slopes, 1,280 feet south and 680 feet east of northwest corner sec. 27, T. 7 N., R. 67 W.

Ap—0 to 7 inches; light yellowish brown (2.5Y 6/3) fine sandy loam, light olive brown (2.5Y 5/3) moist; weak medium granular structure; very hard, very friable; calcareous; mildly alkaline; clear wavy boundary.

C1—7 to 11 inches; light yellowish brown (2.5Y 6/3) very fine sandy loam, light olive brown (2.5Y 5/3) moist; massive; very hard, friable; calcareous; moderately alkaline; 50 percent weathered sandstone fragments; clear smooth boundary.

C2r—11 inches; calcareous sandstone.

Typically these soils have free carbonates at the surface. Depth to sandstone ranges from 10 to 20 inches. Content of rock fragments ranges from 5 to 60 percent.

The A horizon has hue of 10YR or 2.5Y, value of 5 to 7 dry and 4 or 5 moist, and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y.

Terry series

The Terry series consists of moderately deep, well drained soils that formed in residuum from calcareous sandstone. Terry soils are on plains. Slopes are 0 to 9 percent.

Terry soils are similar to Vona soils and are near the Otero, Tassel, and Thedalund soils. Vona and Otero soils are deep. Tassel soils have sandstone between 10 and 20 inches. Thedalund soils lack a Bt horizon and have more than 18 percent clay in the C horizon.

Typical pedon of Terry fine sandy loam, 0 to 3 percent slopes, 300 feet north and 100 feet west of southeast corner sec. 22, T. 5 N., R. 61 W.

A1—0 to 6 inches; pale brown (10YR 6/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; few scattered sandstone fragments; neutral; clear smooth boundary.

B2t—6 to 18 inches; pale brown (10YR 6/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable; few thin clay films on faces of some peds; few scattered sandstone fragments; neutral; clear wavy boundary.

B3ca—18 to 27 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; slightly hard, very friable; few scattered sandstone fragments; some visible lime occuring in fine seams and soft masses; calcareous; moderately alkaline; clear wavy boundary.

C1ca—27 to 37 inches; very pale brown (10YR 7/3) fine sandy loam, light brownish gray (10YR 6/2) moist; massive; slightly hard, very friable; few scattered sandstone fragments; some visible lime occuring in medium seams and soft masses; calcareous; moderately alkaline; clear wavy boundary.

C2r—37 inches; calcareous soft sandstone which increases in hardness with depth.

Thickness of the solum ranges from 20 to 30 inches. Depth to sandstone ranges from 20 to 40 inches. Content of coarse fragments ranges from 0 to 15 percent. Depth to free carbonates ranges from 12 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 6 or 7 dry and 3 or 4 moist, and chroma of 2 or 3. The B2t horizon is commonly fine sandy loam that is 10 to 18 percent clay.

Thedalund series

The Thedalund series consists of moderately deep, well drained soils that formed in residuum from soft calcareous shale. Thedalund soils are on plains. Slopes are 1 to 9 percent.

Thedalund soils are similar to Kim, Nelson, Otero, Shingle, and Tassel soils and are near the Olney and Terry soils. Kim, Otero, and Olney soils are deep. Nelson and Tassel soils are less than 18 percent clay in the C horizon. Terry soils have a B2t horizon that is less than 18 percent clay. Shingle soils have shale between 10 and 20 inches.

Typical pedon of Thedalund loam, 3 to 9 percent slopes, 2,050 feet north and 1,800 feet east of southwest corner sec. 29, T. 7 N., R. 65 W.

Ap—0 to 8 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; moderate fine granular structure; slightly hard, friable; 5 percent shale chips; calcareous; moderately alkaline; abrupt smooth boundary.

C1ca—8 to 12 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak fine granular structure; slightly hard, friable; some visible lime in medium soft masses; calcareous; moderately alkaline; clear smooth boundary.

C2ca—12 to 25 inches; very pale brown (10YR 7/4) loam stratified with thin lenses of shale, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable; some visible lime occuring in medium soft masses; calcareous; moderately alkaline; abrupt smooth boundary.

C3r—25 inches; soft calcareous shale.

Typically these soils have free carbonates at the surface. Depth to shale ranges from 20 to 40 inches. Content of rock fragments ranges from 0 to 15 percent.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 or 3. The C horizon has hue of 10YR or 2.5Y. It is loam or clay loam that is 18 to 35 percent clay.

Ulm series

The Ulm series consists of deep, well drained soils that formed in calcareous alluvial and eolian sediments from shale. Ulm soils are on plains. Slopes are 0 to 5 percent.

Ulm soils are similar to the Fort Collins, Renohill, and Wiley soils and are near the Heldt and Nunn soils. Fort Collins and Wiley soils are less than 35 percent clay in the B2t horizon. Renohill soils have shale between 20 and 40 inches. Heldt soils lack a B2t horizon. Nunn soils have a dark colored surface layer.

Typical pedon of Ulm clay loam, 0 to 3 percent slopes, 1,370 feet north and 240 feet west of southeast corner sec. 33, T. 1 N., R. 68 W.

Ap—0 to 5 inches; brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; slightly hard, firm; calcareous; mildly alkaline; abrupt smooth boundary.

B2t—5 to 13 inches; brown (10YR 5/3) clay, dark grayish brown (10YR 4/2) moist; weak coarse angular blocky structure parting to moderate medium angular blocky; extremely hard, extremely firm; common moderately thick clay films on faces of peds; calcareous; mildly alkaline; clear smooth boundary.

B3ca—13 to 19 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; weak coarse angular blocky structure; extremely hard, extremely firm; few thin clay films on faces of some peds; some visible lime in fine seams; calcareous; moderately alkaline; gradual smooth boundary.

C1ca—19 to 34 inches; very pale brown (10YR 7/3) clay, pale brown (10YR 6/3) moist; weak coarse subangular blocky structure; extremely hard, very firm; some visible lime occuring in medium soft masses; calcareous; moderately alkaline; gradual smooth boundary.

C2ca—34 to 60 inches; very pale brown (10YR 7/3) clay loam, pale brown (10YR 6/3) moist; weak coarse subangular blocky structure; very hard, firm; some visible lime occuring in medium soft masses; calcareous; moderately alkaline.

Thickness of the solum ranges from 15 to 36 inches. Rock fragments make up 0 to 5 percent of the solum.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6 dry and 4 or 5 moist, and chroma of 2 or 3. The B2t horizon is commonly clay that is 40 to 50 percent clay.

Valent series

The Valent series consists of deep, excessively drained soils that formed in eolian deposits. Valent soils are on plains. Slopes are 0 to 9 percent.

Valent soils are near the Loup, Boel, Osgood, and Vona soils. Loup and Boel soils are poorly drained. Osgood and Vona soils have a B horizon.

Typical pedon of Valent sand, 0 to 3 percent slopes, 2,220 feet north and 132 feet west of southeast corner sec. 8, T. 4 N., R. 62 W.

A1—0 to 8 inches; brown (10YR 5/3) sand, dark grayish brown (10YR 4/2) moist; single grained; loose; neutral; clear smooth boundary.

C1—8 to 60 inches; brown (10YR 5/3) sand, dark grayish brown (10YR 4/2) moist; single grained; loose; neutral.

Coarse fragments make up 0 to 10 percent of the solum and are mainly scattered gravel. Depth to free carbonates is more than 40 inches.

The A horizon has hue of 10YR and 2.5Y, value of 5 or 6 dry and 3 to 5 moist, and chroma of 2 or 3.

Vona series

The Vona series consists of deep, well drained to somewhat excessively drained soils that formed in eolian or alluvial deposits. Vona soils are on plains and high terraces. Slopes are 0 to 9 percent.

Vona soils are similar to the Olney and Terry soils and are near the Ascalon, Bresser, Julesburg, Osgood, Otero, and Valent soils. Olney, Ascalon, and Bresser soils are more than 18 percent clay in the B2t horizon. Terry soils have sandstone between 20 and 40 inches. Julesburg soils have a dark colored surface layer. Osgood soils have an A horizon that is coarser than loamy fine sand and is more than 20 inches thick. Otero and Valent soils lack a B horizon.

Typical pedon of Vona loamy sand, 0 to 3 percent slopes, 180 feet north and 1,400 feet east of southwest corner sec. 25, T. 5 N., R. 61 W.

A1—0 to 6 inches; grayish brown (10YR 5/2) loamy sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; neutral; clear smooth boundary.

A3—6 to 12 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable; neutral; clear smooth boundary.

B21t—12 to 16 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; few thin clay films on faces of peds; neutral; clear smooth boundary.

B22t—16 to 22 inches; yellowish brown (10YR 5/4) fine sandy loam, brown (10YR 4/3) moist; moderate medium prismatic structure parting to weak medium subangular blocky; hard, friable; few thin clay films on faces of peds; neutral; gradual smooth boundary.

B3—22 to 28 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; weak coarse subanglar blocky structure; slightly hard, very friable; calcareous; mildly alkaline; clear smooth boundary.

Cca—28 to 60 inches; light yellowish brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable; some visible lime in fine filaments or threads; calcareous; moderately alkaline.

Thickness of the solum ranges from 18 to 37 inches. Coarse fragments make up 0 to 10 percent of the solum. Depth to free carbonates ranges from 12 to 24 inches.

The A horizon has value of 5 or 6 dry and 3 to 5 moist and chroma of 2 or 3. It is loamy sand or sandy loam. The B2t horizon is commonly fine sandy loam that is 10 to 18 percent clay. The C horizon ranges from coarse loamy sand to sandy loam.

Weld series

The Weld series consists of deep, well drained soils that formed in calcareous eolian deposits. Weld soils are on smooth plains. Slopes are 0 to 5 percent.

Weld soils are near the Adena, Colby, Nunn, and Wiley soils. Adena soils have a light colored surface layer and solum less than 15 inches thick. Colby soils lack a B horizon. Wiley soils have a light colored surface layer and less clay in the B2t horizon. Nunn soils lack an abrupt textural boundary between the A and B horizon.

Typical pedon of Weld loam, 1 to 3 percent slopes, 2,470 feet south and 200 feet west of northeast corner sec. 35, T. 1 N., R. 61 W.

Ap—0 to 8 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate medium granular structure; hard, friable; neutral; abrupt smooth boundary.

B21t—8 to 12 inches; brown (10YR 5/3) light clay, brown (10YR 4/3) moist; strong fine prismatic structure parting to strong fine angular blocky; very hard, firm; many moderately thick clay films on faces of peds; neutral; clear smooth boundary.

B22t—12 to 15 inches; pale brown (10YR 6/3) heavy clay loam, brown (10YR 4/3) moist; strong fine prismatic structure parting to strong fine angular blocky; very hard, firm; many moderately thick clay films on faces of peds; neutral; clear smooth boundary.

B3ca—15 to 28 inches; very pale brown (10YR 7/3) loam, pale brown (10YR 6/3) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable; few thin clay films on faces of some peds; some visible lime occuring in fine soft masses; calcareous; moderately alkaline; clear smooth boundary.

Cca—28 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; slightly hard, friable; some visible lime in fine filaments or threads; calcareous; moderately alkaline.

Thickness of the solum ranges from 20 to 39 inches. Depth to free carbonates ranges from 10 to 20 inches.

The A horizon has value of 4 or 5 dry and 2 or 3 moist and chroma of 2 or 3. The B2t horizon is commonly light clay or heavy clay loam that is 35 to 45 percent clay. The C horizon is commonly silt loam or loam.

Wiley series

The Wiley series consists of deep, well drained soils that formed in calcareous eolian deposits. Wiley soils are on plains. Slopes are 0 to 5 percent.

Wiley soils are similar to the Renohill and Ulm soils and are near the Colby, Heldt, and Weld soils. Renohill soils have shale between 20 and 40 inches. Ulm, Heldt, and Weld soils are more than 35 percent clay in the B2 horizon. Colby soils lack a B horizon.

Typical pedon of Wiley silt loam in an area of Wiley-Colby complex, 1 to 3 percent slopes, in the northeast quarter sec. 34, T. 3 N., R. 68 W.

Ap—0 to 11 inches; pale brown (10YR 6/3) silt loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; very hard, friable; calcareous; mildly alkaline; clear smooth boundary.

B2t—11 to 24 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; few thin clay films on faces of peds; calcareous; moderately alkaline; gradual smooth boundary.

B3ca—24 to 34 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; some visible lime in fine filaments and seams; calcareous; moderately alkaline; gradual smooth boundary.

Cca—34 to 60 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; massive; very hard, friable; some visible lime in fine soft masses; calcareous; moderately alkaline.

Thickness of the solum ranges from 16 to 40 inches. Typically these soils have free carbonates at the surface.

The A horizon has hue of 10YR or 2.5Y, value of 5 to 7 dry and 3 to 5 moist, and chroma of 2 or 3. The B2t horizon is commonly silty clay loam that is 28 to 35 percent clay. The C horizon is commonly silty clay loam or silt loam.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Low	0 to 3.5
Moderate	3.5 to 7.5
High	More than 7.5

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the bases of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures is difficult.

Complex, soil. A mapping unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping (or contour farming). Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. A delay in grazing until range plants have reached a specified stage of growth. Grazing is deferred in order to increase the vigor of forage and to allow desirable plants to produce seed. Contrasts with continuous grazing and rotation grazing.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils

are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Excess alkali. Excess exchangeable sodium. The resulting poor physical properties restrict the growth of plants.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime. Excess carbonates. Excessive carbonates, or lime, restrict the growth of some plants.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake. The rapid movement of water into the soil.

Favorable. Favorable soil features for the specified use.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May,* for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forage. Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

Forb. Any herbaceous plant not a grass or a sedge.

Frost action. Freezing and thawing of soil moisture. Frost action can damage structures and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green manure (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsum. Hydrous calcium sulphate.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does

not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants are those that follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Large stones. Rock fragments 10 inches (25 centimeters) or more across. Large stones adversely affect the specified use.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous areas. Areas that have little or no natural soil, are too nearly inaccessible for orderly examination, or cannot otherwise be feasibly classified.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water of subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Range condition. The health or productivity of forage plants on a given range, in terms of the potential productivity under normal climate and the best practical management. Condition classes generally recognized are—*excellent, good, fair,* and *poor.* The classification is based on the percentage of original, or assumed climax vegetation on a site, as compared to what has been observed to grow on it when well managed.

Range site. An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock. Soil scientists regard as soil only the part of the regolith that is modified by organisms and other soil-building forces. Most engineers describe the whole regolith, even to a great depth, as "soil."

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.005 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy*

(laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitaion is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Trace elements. The chemical elements in soils, in only extremely small amounts, essential to plant growth. Examples are zinc, cobalt, manganese, copper, and iron.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Illustrations

Figure 1.—One of many feedlots in the survey area.

Figure 2.—Typical landscape of Olney-Kim-Otero map unit.

Figure 3.—Typical landscape of Nunn-Dacono-Altvan map unit.

Figure 4.—Irrigating sugar beets from a concrete-lined irrigation ditch.

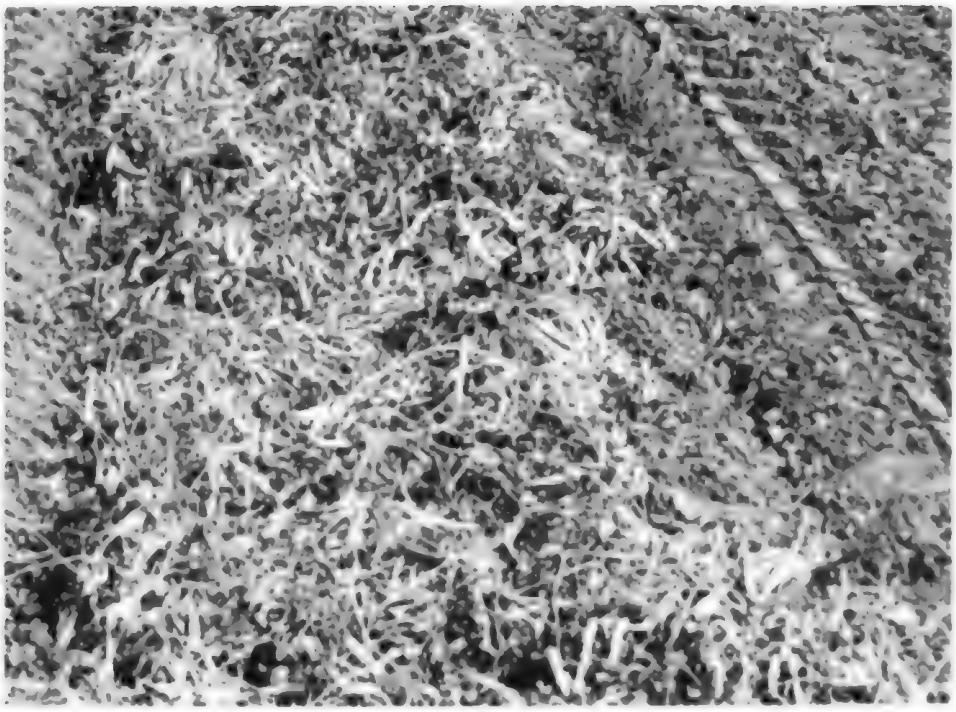

Figure 5.—Pinto beans ready for harvest on Fort Collins loam.

Figure 6.—Cement-lined canal and supply ditch on Kim loam.

Figure 7.—Irrigated alfalfa hay on Vona sandy loam.

Figure 8.—Circular sprinkler for sugar beets on Weld loam.

Figure 9.—Olney and Otero soils. Land leveling cut is 10 feet.

Figure 10.—Dryland wheat and summer fallow on Weld loam.

Figure 11.—Sandstone Breaks range site on Tassel fine sandy loam.

Figure 12.—Deep Sand range site in excellent condition on Valent sand.

Figure 13.—An excellent farmstead windbreak on irrigated cropland.

Figure 14.—Recreational area along St. Vrain Creek.

Figure 15.—Windbreak on Weld-Colby map unit in Banner Lakes Recreation Area. Shrubs provide food and cover for wildlife.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION DATA

Month	Temperature[1]						Precipitation[1]				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[2]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F		In	In	In		In
January----	39.9	10.5	25.3	65	-19	37	.35	.08	.55	1	5.3
February---	45.3	16.4	30.9	71	-11	57	.29	.15	.41	1	4.6
March------	51.2	22.5	36.8	78	-4	100	.76	.30	1.12	3	8.1
April------	61.8	32.7	47.3	84	12	248	1.36	.46	2.07	3	4.3
May--------	72.6	43.3	58.0	92	27	558	2.16	.87	3.20	5	.3
June-------	82.8	52.0	67.4	100	39	822	1.81	.74	2.67	4	.0
July-------	89.3	57.3	73.4	100	47	1,035	1.24	.47	1.85	3	.0
August-----	86.9	54.9	70.9	99	43	958	1.22	.42	1.85	3	.0
September--	77.8	44.6	61.3	94	29	639	1.33	.36	2.10	3	.6
October----	66.8	33.8	50.3	85	16	333	.91	.22	1.46	2	3.0
November---	50.8	21.7	36.3	74	-1	65	.53	.14	.84	2	5.4
December---	42.0	13.9	28.0	67	-13	8	.31	.04	.52	1	4.1
Year-----	63.9	33.6	48.8	101	-21	4,860	12.27	9.55	14.84	31	35.7

[1]Recorded in the period 1951-74 at Greeley, CO.

[2]A growing degree day is an index of the amount of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature[1]		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 28	May 11	May 24
2 years in 10 later than--	April 22	May 5	May 19
5 years in 10 later than--	April 11	April 25	May 10
First freezing temperature in fall:			
1 year in 10 earlier than--	October 4	September 25	September 16
2 years in 10 earlier than--	October 10	October 1	September 21
5 years in 10 earlier than--	October 21	October 11	September 30

[1]Recorded in the period 1951-74 at Greeley, CO.

TABLE 3.--GROWING SEASON LENGTH

Probability	Daily minimum temperature during growing season[1]		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	166	147	122
8 years in 10	175	155	129
5 years in 10	192	168	143
2 years in 10	209	182	156
1 year in 10	218	189	163

[1]Recorded in the period 1951-74 at Greeley, CO.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Altvan loam, 0 to 1 percent slopes	19,740	1.7
2	Altvan loam, 1 to 3 percent slopes	2,140	0.2
3	Aquolls and Aquents, gravelly substratum	34,030	3.0
4	Aquolls and Aquepts, flooded	22,530	2.0
5	Ascalon sandy loam, 1 to 3 percent slopes	12,280	1.1
6	Ascalon sandy loam, 3 to 5 percent slopes	8,452	0.7
7	Ascalon sandy loam, 5 to 9 percent slopes	640	0.1
8	Ascalon loam, 0 to 1 percent slopes	4,290	0.4
9	Ascalon loam, 1 to 3 percent slopes	960	0.1
10	Bankard sandy loam, 0 to 3 percent slopes	19,980	1.7
11	Bresser sandy loam, 0 to 1 percent slopes	1,620	0.1
12	Bresser sandy loam, 1 to 3 percent slopes	1,220	0.1
13	Cascajo gravelly sandy loam, 5 to 20 percent slopes	1,830	0.2
14	Colby loam, 0 to 1 percent slopes	7,748	0.7
15	Colby loam, 1 to 3 percent slopes	19,310	1.7
16	Colby loam, 3 to 5 percent slopes	7,220	0.6
17	Colby loam, 5 to 9 percent slopes	3,930	0.3
18	Colby-Adena loams, 3 to 9 percent slopes	21,060	1.8
19	Colombo clay loam, 0 to 1 percent slopes	9,110	0.8
20	Colombo clay loam, 1 to 3 percent slopes	4,120	0.4
21	Dacono clay loam, 0 to 1 percent slopes	10,960	1.0
22	Dacono clay loam, 1 to 3 percent slopes	1,300	0.1
23	Fort Collins loam, 0 to 1 percent slopes	880	0.1
24	Fort Collins loam, 1 to 3 percent slopes	2,540	0.2
25	Haverson loam, 0 to 1 percent slopes	10,890	0.9
26	Haverson loam, 1 to 3 percent slopes	9,290	0.8
27	Heldt silty clay, 1 to 3 percent slopes	2,170	0.2
28	Heldt silty clay, 3 to 5 percent slopes	140	*
29	Julesburg sandy loam, 0 to 1 percent slopes	6,920	0.6
30	Julesburg sandy loam, 1 to 3 percent slopes	2,040	0.2
31	Kim loam, 0 to 1 percent slopes	4,150	0.4
32	Kim loam, 1 to 3 percent slopes	40,960	3.6
33	Kim loam, 3 to 5 percent slopes	7,090	0.6
34	Kim loam, 5 to 9 percent slopes	6,250	0.5
35	Loup-Boel loamy sands, 0 to 3 percent slopes	11,050	1.0
36	Midway-Shingle complex, 5 to 20 percent slopes	1,630	0.1
37	Nelson fine sandy loam, 0 to 3 percent slopes	3,820	0.3
38	Nelson fine sandy loam, 3 to 9 percent slopes	6,210	0.5
39	Nunn loam, 0 to 1 percent slopes	7,740	0.7
40	Nunn loam, 1 to 3 percent slopes	16,520	1.4
41	Nunn clay loam, 0 to 1 percent slopes	20,900	1.8
42	Nunn clay loam, 1 to 3 percent slopes	18,940	1.6
43	Nunn loamy sand, 0 to 1 percent slopes	2,320	0.2
44	Olney loamy sand, 1 to 3 percent slopes	19,950	1.7
45	Olney loamy sand, 3 to 5 percent slopes	3,330	0.3
46	Olney fine sandy loam, 0 to 1 percent slopes	8,730	0.8
47	Olney fine sandy loam, 1 to 3 percent slopes	58,300	5.1
48	Olney fine sandy loam, 3 to 5 percent slopes	15,040	1.3
49	Osgood sand, 0 to 3 percent slopes	38,100	3.3
50	Otero sandy loam, 0 to 1 percent slopes	4,190	0.4
51	Otero sandy loam, 1 to 3 percent slopes	30,970	2.7
52	Otero sandy loam, 3 to 5 percent slopes	13,440	1.2
53	Otero sandy loam, 5 to 9 percent slopes	6,710	0.6
54	Paoli loam, 0 to 1 percent slopes	600	0.1
55	Paoli loam, 1 to 3 percent slopes	250	*
56	Renohill clay loam, 0 to 3 percent slopes	4,020	0.3
57	Renohill clay loam, 3 to 9 percent slopes	4,860	0.4
58	Shingle loam, 1 to 3 percent slopes	1,540	0.1
59	Shingle loam, 3 to 9 percent slopes	1,160	0.1
60	Shingle-Renohill complex, 3 to 9 percent slopes	1,090	0.1
61	Tassel fine sandy loam, 5 to 20 percent slopes	6,140	0.5
62	Terry fine sandy loam, 0 to 3 percent slopes	1,990	0.2
63	Terry fine sandy loam, 3 to 9 percent slopes	6,800	0.6
64	Thedalund loam, 1 to 3 percent slopes	7,580	0.7
65	Thedalund loam, 3 to 9 percent slopes	3,600	0.3
66	Ulm clay loam, 0 to 3 percent slopes	4,610	0.4
67	Ulm clay loam, 3 to 5 percent slopes	2,810	0.2
68	Ustic Torriorthents, moderately steep	2,900	0.3
69	Valent sand, 0 to 3 percent slopes	65,950	5.7
70	Valent sand, 3 to 9 percent slopes	174,010	15.0

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
71	Valent-Loup complex, 0 to 9 percent slopes	3,520	0.3
72	Vona loamy sand, 0 to 3 percent slopes	66,670	5.8
73	Vona loamy sand, 3 to 5 percent slopes	18,390	1.6
74	Vona loamy sand, 5 to 9 percent slopes	31,045	2.7
75	Vona sandy loam, 0 to 1 percent slopes	5,260	0.5
76	Vona sandy loam, 1 to 3 percent slopes	14,600	1.3
77	Vona sandy loam, 3 to 5 percent slopes	6,310	0.5
78	Weld loam, 0 to 1 percent slopes	5,820	0.5
79	Weld loam, 1 to 3 percent slopes	60,470	5.2
80	Weld loam, 3 to 5 percent slopes	2,300	0.2
81	Wiley-Colby complex, 0 to 1 percent slopes	790	0.1
82	Wiley-Colby complex, 1 to 3 percent slopes	26,615	2.3
83	Wiley-Colby complex, 3 to 5 percent slopes	6,870	0.6
	Water	17,750	1.5
	Total	1,152,000	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF IRRIGATED CROPS

[All yields were estimated for a high level of management in 1975. Absence of a yield figure indicates the crop is seldom grown or is not suited]

Soil name and map symbol	Alfalfa hay	Sugar beets	Corn	Corn silage	Beans, dry pinto	Onions	Potatoes
	Ton	Ton	Bu	Ton	Lb	Sack	Cwt
1, 2---------- Altvan	5.0	23	160	33	2400	525	325
3---------- Aquolls	---	---	---	---	---	---	---
4---------- Aquolls	---	---	---	---	---	---	---
5---------- Ascalon	---	---	---	---	---	---	---
6---------- Ascalon	---	---	---	---	---	---	---
7---------- Ascalon	---	---	---	---	---	---	---
8---------- Ascalon	5.5	24	180	35	2700	550	350
9---------- Ascalon	5.5	23	160	33	2400	525	325
10---------- Bankard	2.5	---	50	---	---	---	---
11---------- Bresser	5.5	24	180	35	2700	550	350
12---------- Bresser	5.5	23	160	33	2400	525	325
13---------- Cascajo	---	---	---	---	---	---	---
14---------- Colby	5.5	24	180	35	2700	---	---
15---------- Colby	5.5	23	160	33	2400	---	---
16---------- Colby	4.0	18	100	23	1800	---	---
17---------- Colby	3.0	---	80	20	---	---	---
18---------- Colby	---	---	---	---	---	---	---
19*---------- Colombo	5.5	24	170	35	2700	550	350
20*---------- Colombo	5.5	23	160	33	2400	525	325
21---------- Dacono	5.5	26	170	33	2400	525	325
22---------- Dacono	5.5	25	150	30	2400	525	325
23---------- Fort Collins	5.5	24	180	35	2700	550	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF IRRIGATED CROPS--Continued

Soil name and map symbol	Alfalfa hay	Sugar beets	Corn	Corn silage	Beans, dry pinto	Onions	Potatoes
	Ton	Ton	Bu	Ton	Lb	Sack	Cwt
24--Fort Collins	5.5	23	160	33	2400	525	---
25--Haverson	5.5	23	160	33	2400	---	---
26--Haverson	5.5	20	150	30	2400	---	---
27--Heldt	4.5	20	---	25	---	---	---
28--Heldt	4.0	---	---	25	---	---	---
29--Julesburg	5.5	23	180	35	2400	525	350
30--Julesburg	5.5	23	160	33	2400	525	325
31--Kim	5.5	24	180	30	2700	550	350
32--Kim	5.5	23	160	30	2400	525	325
33--Kim	4.0	20	140	25	---	---	---
34--Kim	3.0	---	80	20	---	---	---
35--Loup	2.5	---	---	25	1200	---	---
36--Midway	---	---	---	---	---	---	---
37--Nelson	4.0	21	120	30	2400	---	---
38--Nelson	3.0	---	70	25	---	---	---
39--Nunn	5.5	24	180	35	2700	550	350
40--Nunn	5.5	23	160	33	2400	525	325
41--Nunn	5.5	24	180	35	2700	550	350
42--Nunn	5.5	23	160	33	2400	525	325
43--Nunn	5.0	20	150	30	2000	---	---
44--Olney	5.0	20	140	30	2400	525	325
45--Olney	3.5	---	80	20	---	---	---
46--Olney	5.5	24	180	35	2700	550	350

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF IRRIGATED CROPS--Continued

Soil name and map symbol	Alfalfa hay	Sugar beets	Corn	Corn silage	Beans, dry pinto	Onions	Potatoes
	Ton	Ton	Bu	Ton	Lb	Sack	Cwt
47---------- Olney	5.5	23	160	33	2400	525	325
48---------- Olney	4.0	---	100	25	1800	---	---
49---------- Osgood	3.0	---	80	20	---	---	---
50---------- Otero	5.5	23	170	33	2400	525	325
51---------- Otero	5.0	22	150	30	1800	500	---
52---------- Otero	4.0	18	100	25	---	---	---
53---------- Otero	3.0	---	80	20	---	---	---
54---------- Paoli	5.0	23	180	35	2700	---	350
55---------- Paoli	5.0	23	160	33	2400	---	325
56---------- Renohill	3.0	18	100	25	---	---	---
57---------- Renohill	2.0	---	80	20	---	---	---
58---------- Shingle	2.0	---	---	17	---	---	---
59---------- Shingle	---	---	---	---	---	---	---
60---------- Shingle	---	---	---	---	---	---	---
61---------- Tassel	---	---	---	---	---	---	---
62---------- Terry	4.0	20	120	30	2400	---	---
63---------- Terry	3.0	---	70	25	---	---	---
64---------- Thedalund	4.0	20	130	30	2400	---	---
65---------- Thedalund	3.0	---	80	25	---	---	---
66---------- Ulm	5.5	---	160	33	---	---	---
67---------- Ulm	4.0	---	100	25	---	---	---
68**---------- Ustic Torriorthents	---	---	---	---	---	---	---
69, 70---------- Valent	3.5	---	80	22	---	---	---
71---------- Valent	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF IRRIGATED CROPS--Continued

Soil name and map symbol	Alfalfa hay	Sugar beets	Corn	Corn silage	Beans, dry pinto	Onions	Potatoes
	Ton	Ton	Bu	Ton	Lb	Sack	Cwt
72---------- Vona	4.5	20	140	30	---	---	275
73---------- Vona	3.5	---	80	22	---	---	---
74---------- Vona	---	---	---	---	---	---	---
75---------- Vona	5.0	23	160	30	2400	525	325
76---------- Vona	4.5	20	140	30	1800	525	325
77---------- Vona	4.0	18	100	25	---	---	---
78---------- Weld	5.5	24	180	35	2700	---	---
79---------- Weld	5.5	23	160	33	2400	---	---
80---------- Weld	4.0	20	100	25	1800	---	---
81---------- Wiley	5.5	24	180	35	2700	---	---
82---------- Wiley	5.5	23	160	33	2400	---	---
83---------- Wiley	4.0	20	100	25	1800	---	---

* Yields are for areas protected from flooding.
** See map unit description for the composition and behavior of the map unit.

TABLE 6.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1, 2 Altvan	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, frost action.
3*: Aquolls	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, frost action.
Aquents	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, frost action.
4*: Aquolls	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, frost action.
Aquepts	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness, frost action.
5 Ascalon	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: frost action, low strength.
6, 7 Ascalon	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: slope, low strength.	Moderate: frost action, low strength.
8, 9 Ascalon	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: frost action, low strength.
10 Bankard	Severe: cutbanks cave, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
11, 12 Bresser	Slight	Slight	Slight	Slight	Moderate: frost action.
13 Cascajo	Severe: cutbanks cave, small stones.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
14, 15 Colby	Slight	Slight	Slight	Slight	Moderate: low strength.
16, 17 Colby	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
18*: Colby	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
Adena	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.

See footnote at end of table.

TABLE 6.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
19---------- Colombo	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
20---------- Colombo	Slight----------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, frost action.
21, 22---------- Dacono	Severe: cutbanks cave.	Moderate: low strength, shrink-swell.	Slight----------	Moderate: low strength, shrink-swell.	Severe: shrink-swell, low strength.
23, 24---------- Fort Collins	Slight----------	Moderate: low strength.	Moderate: low strength, shrink-swell.	Moderate: low strength.	Moderate: low strength.
25, 26---------- Haverson	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
27, 28---------- Heldt	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
29, 30---------- Julesburg	Slight----------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, frost action.
31, 32---------- Kim	Slight----------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.
33, 34---------- Kim	Slight----------	Moderate: low strength.	Moderate: low strength.	Moderate: low strength, slope.	Moderate: low strength.
35*:					
Loup----------	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness.
Boel----------	Severe: wetness, floods, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
36*:					
Midway----------	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength.
Shingle----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.
37---------- Nelson	Severe: depth to rock.	Moderate: depth to rock, low strength.	Severe: depth to rock.	Moderate: depth to rock, low strength.	Moderate: depth to rock, low strength.
38---------- Nelson	Severe: depth to rock.	Moderate: depth to rock, low strength.	Severe: depth to rock.	Moderate: slope, depth to rock, low strength.	Moderate: depth to rock, low strength.
39, 40, 41, 42, 43---------- Nunn	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.

See footnote at end of table.

TABLE 6.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
44---- Olney	Slight	Slight	Slight	Slight	Moderate: low strength.
45---- Olney	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
46, 47---- Olney	Slight	Slight	Slight	Slight	Moderate: low strength.
48---- Olney	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength.
49---- Osgood	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
50, 51---- Otero	Slight	Slight	Slight	Slight	Slight.
52, 53---- Otero	Slight	Slight	Slight	Moderate: slope.	Slight.
54---- Paoli	Slight	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, frost action.
55---- Paoli	Slight	Slight	Slight	Slight	Moderate: low strength, frost action.
56---- Renohill	Moderate: depth to rock, too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, depth to rock, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength, shrink-swell.
57---- Renohill	Moderate: depth to rock, too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, depth to rock, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: low strength, shrink-swell.
58, 59---- Shingle	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
60*: Shingle----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Renohill----	Moderate: depth to rock, too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, depth to rock, shrink-swell.	Moderate: slope, low strength, shrink-swell.	Severe: low strength, shrink-swell.
61---- Tassel	Moderate: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.	Severe: slope.	Moderate: depth to rock.
62---- Terry	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock.	Moderate: depth to rock.
63---- Terry	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock.
64---- Thedalund	Moderate: depth to rock.	Moderate: low strength.	Moderate: depth to rock.	Moderate: low strength.	Moderate: low strength.
65---- Thedalund	Moderate: depth to rock.	Moderate: low strength.	Moderate: depth to rock.	Moderate: low strength, slope.	Moderate: low strength.

See footnote at end of table.

TABLE 6.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
66, 67---- Ulm	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
68*---- Ustic Torriorthents	Severe: small stones, cutbanks cave.	Moderate: slope.	Moderate: slope.	Moderate: slope.	Moderate: slope.
69---- Valent	Severe: cutbanks cave.	Slight----	Slight----	Slight----	Slight.
70---- Valent	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Slight.
71*: Valent----	Severe: cutbanks cave.	Slight----	Slight----	Moderate: slope.	Slight.
Loup----	Severe: wetness, cutbanks cave.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness.
72---- Vona	Slight----	Slight----	Slight----	Slight----	Moderate: low strength.
73, 74---- Vona	Slight----	Slight----	Slight----	Moderate: slope.	Moderate: low strength.
75, 76---- Vona	Slight----	Slight----	Slight----	Slight----	Moderate: low strength.
77---- Vona	Slight----	Slight----	Slight----	Moderate: slope.	Moderate: low strength.
78, 79---- Weld	Slight----	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell, frost action.
80---- Weld	Slight----	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, slope, shrink-swell.	Moderate: low strength, shrink-swell, frost action.
81*, 82*: Wiley----	Slight----	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.
Colby----	Slight----	Slight----	Slight----	Slight----	Moderate: low strength.
83*: Wiley----	Slight----	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, slope, shrink-swell.	Moderate: low strength, shrink-swell.
Colby----	Slight----	Slight----	Slight----	Moderate: slope.	Moderate: low strength.

* See map unit description for the composition and behavior of the map unit.

TABLE 7.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1, 2---------- Altvan	Slight----------	Severe: seepage.	Severe: seepage.	Slight----------	Fair: thin layer.
3*: Aquolls----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness.	Poor: wetness.
Aquents----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness.	Poor: wetness.
4*: Aquolls----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness.	Poor: wetness.
Aquepts----------	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: wetness.	Poor: wetness.
5, 6---------- Ascalon	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
7---------- Ascalon	Slight----------	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Good.
8, 9---------- Ascalon	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
10---------- Bankard	Severe: floods.	Severe: floods, seepage.	Severe: floods, seepage.	Severe: floods.	Fair: too sandy.
11, 12---------- Bresser	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
13---------- Cascajo	Moderate: slope.	Severe: slope, seepage, small stones.	Severe: seepage.	Severe: seepage.	Poor: small stones.
14, 15, 16---------- Colby	Slight----------	Moderate: seepage.	Slight----------	Slight----------	Good.
17---------- Colby	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
18*: Colby----------	Slight----------	Severe: slope.	Slight----------	Slight----------	Good.
Adena----------	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
19---------- Colombo	Moderate: floods.	Severe: floods.	Moderate: floods.	Moderate: floods.	Good.
20---------- Colombo	Slight----------	Moderate: slope, seepage.	Slight----------	Slight----------	Good.

See footnote at end of table.

TABLE 7.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
21, 22--- Dacono	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight---	Fair: too clayey.
23--- Fort Collins	Moderate: percs slowly.	Moderate: seepage.	Slight---	Slight---	Good.
24--- Fort Collins	Moderate: percs slowly.	Moderate: seepage, slope.	Slight---	Slight---	Good.
25, 26--- Haverson	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Good.
27, 28--- Heldt	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight---	Poor: too clayey.
29, 30--- Julesburg	Slight---	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
31--- Kim	Slight---	Moderate: seepage.	Slight---	Slight---	Good.
32, 33--- Kim	Slight---	Moderate: seepage, slope.	Slight---	Slight---	Good.
34--- Kim	Slight---	Severe: slope.	Slight---	Slight---	Good.
35*: Loup---	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods, seepage.	Poor: wetness.
Boel---	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods, seepage.	Severe: wetness, floods.	Poor: too sandy.
36*: Midway---	Severe: percs slowly, depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: slope.	Poor: too clayey, thin layer.
Shingle---	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Moderate: slope.	Severe: thin layer.
37, 38--- Nelson	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: seepage.	Fair: thin layer.
39--- Nunn	Severe: percs slowly.	Moderate: excess humus.	Slight---	Slight---	Fair: too clayey.
40--- Nunn	Severe: percs slowly.	Moderate: excess humus, slope.	Slight---	Slight---	Fair: too clayey.
41--- Nunn	Severe: percs slowly.	Moderate: excess humus.	Slight---	Slight---	Fair: too clayey.
42--- Nunn	Severe: percs slowly.	Moderate: excess humus, slope.	Slight---	Slight---	Fair: too clayey.

See footnote at end of table.

TABLE 7.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
43---------- Nunn	Severe: perc slowly.	Moderate: excess humus.	Slight----------	Slight----------	Fair: too clayey.
44, 45, 46, 47, 48-- Olney	Slight----------	Severe: seepage.	Slight----------	Slight----------	Good.
49---------- Osgood	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
50, 51, 52---------- Otero	Slight----------	Severe: seepage.	Slight----------	Slight----------	Good.
53---------- Otero	Slight----------	Severe: slope, seepage.	Slight----------	Slight----------	Good.
54---------- Paoli	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
55---------- Paoli	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
56, 57---------- Renohill	Severe: perc slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Fair: too clayey, thin layer.
58, 59---------- Shingle	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer.
60*: Shingle----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Poor: thin layer.
Renohill----------	Severe: perc slowly, depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Fair: too clayey, thin layer.
61---------- Tassel	Severe: depth to rock.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: thin layer, area reclaim.
62, 63---------- Terry	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock.	Slight----------	Fair: thin layer, area reclaim.
64, 65---------- Thedalund	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight----------	Fair: thin layer.
66---------- Ulm	Severe: perc slowly.	Slight----------	Moderate: too clayey.	Slight----------	Poor: too clayey.
67---------- Ulm	Severe: perc slowly.	Moderate: slope.	Moderate: too clayey.	Slight----------	Poor: too clayey.
68*---------- Ustic Torriorthents	Moderate: slope.	Severe: seepage, small stones.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, small stones.
69, 70---------- Valent	Slight----------	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy.
71*: Valent----------	Slight----------	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy.

See footnote at end of table.

TABLE 7.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
71*: Loup	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Poor: wetness.
72, 73 Vona	Slight	Severe: seepage.	Slight	Slight	Good.
74 Vona	Slight	Severe: seepage, slope.	Slight	Slight	Good.
75, 76, 77 Vona	Slight	Severe: seepage.	Slight	Slight	Good.
78 Weld	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
79, 80 Weld	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
81*: Wiley	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: too clayey.
Colby	Slight	Moderate: seepage.	Slight	Slight	Good.
82*, 83*: Wiley	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Fair: too clayey.
Colby	Slight	Moderate: seepage.	Slight	Slight	Good.

* See map unit description for the composition and behavior of the map unit.

TABLE 8.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1, 2---------- Altvan	Good----------	Fair: excess fines.	Fair: excess fines.	Fair: thin layer.
3*: Aquolls----------	Poor: wetness, frost action.	Good----------	Fair: excess fines.	Poor: wetness.
Aquents----------	Poor: wetness, frost action.	Good----------	Fair: excess fines.	Poor: wetness.
4*: Aquolls----------	Poor: wetness, frost action.	Unsuited----------	Unsuited----------	Poor: wetness.
Aquepts----------	Poor: wetness, frost action.	Unsuited----------	Unsuited----------	Poor: wetness.
5, 6, 7, 8, 9--------- Ascalon	Fair: low strength, frost action, shrink-swell.	Poor: excess fines.	Unsuited----------	Good.
10---------- Bankard	Fair: low strength.	Fair: excess fines.	Unsuited----------	Poor: too sandy.
11, 12---------- Bresser	Fair: frost action.	Poor: excess fines.	Unsuited----------	Fair: small stones
13---------- Cascajo	Good----------	Good----------	Good----------	Poor: small stones
14, 15, 16, 17-------- Colby	Fair: low strength.	Unsuited----------	Unsuited----------	Good.
18*: Colby----------	Fair: low strength.	Unsuited----------	Unsuited----------	Good.
Adena----------	Fair: low strength.	Unsuited----------	Unsuited----------	Fair: too clayey.
19, 20---------- Colombo	Fair: low strength, frost action.	Unsuited----------	Unsuited----------	Fair: too clayey.
21, 22---------- Dacono	Good----------	Good----------	Good----------	Fair: too clayey.
23, 24---------- Fort Collins	Fair: low strength.	Unsuited----------	Unsuited----------	Good.
25, 26---------- Haverson	Fair: low strength.	Unsuited----------	Unsuited----------	Good.
27, 28---------- Heldt	Poor: shrink-swell, low strength.	Unsuited----------	Unsuited----------	Poor: too clayey.

See footnote at end of table.

TABLE 8.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
29, 30--- Julesburg	Fair: low strength, frost action.	Poor: excess fines.	Unsuited---	Good.
31, 32, 33, 34--- Kim	Fair: low strength.	Unsuited---	Unsuited---	Good.
35*:				
Loup---	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
Boel---	Fair: wetness.	Fair: excess fines.	Unsuited---	Fair: thin layer.
36*:				
Midway---	Poor: shrink-swell, low strength, thin layer.	Unsuited---	Unsuited---	Poor: too clayey.
Shingle---	Poor: thin layer.	Unsuited---	Unsuited---	Poor: area reclaim.
37, 38--- Nelson	Poor: thin layer.	Unsuited---	Unsuited---	Good.
39, 40--- Nunn	Poor: shrink-swell, low strength.	Unsuited---	Unsuited---	Fair: thin layer.
41, 42--- Nunn	Poor: shrink-swell, low strength.	Unsuited---	Unsuited---	Fair: thin layer, too clayey.
43--- Nunn	Poor: shrink-swell, low strength.	Unsuited---	Unsuited---	Poor: too sandy.
44, 45--- Olney	Fair: low strength.	Poor: excess fines.	Unsuited---	Fair: too sandy, thin layer.
46, 47, 48--- Olney	Fair: low strength.	Poor: excess fines.	Unsuited---	Good.
49--- Osgood	Good---	Poor: excess fines.	Unsuited---	Poor: too sandy.
50, 51, 52, 53--- Otero	Good---	Poor: excess fines.	Unsuited---	Good.
54, 55--- Paoli	Fair: low strength, frost action.	Unsuited---	Unsuited---	Good.
56, 57--- Renohill	Poor: low strength, thin layer.	Unsuited---	Unsuited---	Poor: thin layer.
58, 59--- Shingle	Poor: thin layer.	Unsuited---	Unsuited---	Poor: area reclaim.
60*:				
Shingle---	Poor: thin layer.	Unsuited---	Unsuited---	Poor: area reclaim.

See footnote at end of table.

TABLE 8.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
60*: Renohill	Poor: low strength, thin layer.	Unsuited	Unsuited	Poor: thin layer.
61 Tassel	Poor: thin layer, area reclaim.	Unsuited	Unsuited	Poor: area reclaim.
62, 63 Terry	Poor: thin layer, area reclaim.	Unsuited: thin layer.	Unsuited: thin layer.	Fair: small stones.
64, 65 Thedalund	Poor: thin layer.	Unsuited	Unsuited	Good.
66, 67 Ulm	Poor: shrink-swell, low strength.	Unsuited	Unsuited	Fair: too clayey.
68* Ustic Torriorthents	Good	Good	Good	Poor: small stones, too sandy.
69, 70 Valent	Good	Fair	Unsuited	Poor: too sandy.
71*: Valent	Good	Fair	Unsuited	Poor: too sandy.
Loup	Poor: wetness.	Fair: excess fines.	Unsuited: excess fines.	Poor: wetness.
72, 73, 74, 75, 76, 77 Vona	Fair: low strength.	Poor: excess fines.	Unsuited	Good.
78, 79, 80 Weld	Fair: low strength, shrink-swell, frost action.	Unsuited	Unsuited	Fair: too clayey.
81*, 82*, 83*: Wiley	Fair: low strength, shrink-swell.	Unsuited	Unsuited	Fair: too clayey.
Colby	Fair: low strength.	Unsuited	Unsuited	Good.

* See map unit description for the composition and behavior of the map unit.

TABLE 9.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1, 2---------- Altvan	Seepage---------	Thin layer------	Favorable-------	Favorable-------	Rooting depth	Rooting depth.
3*: Aquolls----------	----------	----------	Floods, poor outlets.	Floods, wetness.	Wetness---------	Wetness.
Aquents----------	----------	----------	Floods, poor outlets.	Floods, wetness.	Wetness---------	Wetness.
4*: Aquolls----------	----------	----------	Floods, poor outlets.	Floods, wetness.	Wetness---------	Wetness.
Aquepts----------	----------	----------	Floods, poor outlets.	Floods, wetness.	Wetness---------	Wetness.
5---------- Ascalon	Seepage, slope.	Piping, low strength.	Slope----------	Slope, erodes easily.	Erodes easily, piping.	Erodes easily.
6---------- Ascalon	Seepage, slope.	Piping, low strength.	Slope----------	Slope, erodes easily.	Erodes easily, piping.	Erodes easily, slope.
7---------- Ascalon	Seepage, slope.	Piping, low strength.	Slope----------	Slope, erodes easily.	Erodes easily, piping, slope.	Erodes easily, slope.
8---------- Ascalon	Seepage, slope.	Piping, low strength.	Favorable------	Favorable------	Erodes easily, piping.	Erodes easily.
9---------- Ascalon	Seepage, slope.	Piping, low strength.	Slope----------	Slope, erodes easily.	Erodes easily, piping.	Erodes easily.
10---------- Bankard	Seepage---------	Piping, seepage, erodes easily.	Cutbanks cave, floods, poor outlets.	Droughty, floods, seepage.	Erodes easily, piping.	Droughty, erodes easily.
11---------- Bresser	Seepage---------	Favorable------	Favorable------	Droughty-------	Erodes easily, piping.	Erodes easily.
12---------- Bresser	Seepage, slope.	Favorable------	Slope----------	Slope, erodes easily.	Erodes easily, piping.	Erodes easily.
13---------- Cascajo	Seepage, slope.	Seepage---------	Slope----------	Slope, droughty.	Complex slope, piping, too sandy.	Droughty, slope.
14---------- Colby	Seepage---------	Low strength, piping.	Favorable------	Favorable------	Favorable------	Favorable.
15---------- Colby	Seepage---------	Low strength, piping.	Favorable------	Favorable------	Favorable------	Slope, erodes easily.
16, 17---------- Colby	Seepage---------	Low strength, piping.	Slope----------	Slope, erodes easily.	Favorable------	Slope, erodes easily.
18*: Colby----------	Seepage---------	Low strength, piping.	Slope----------	Slope, erodes easily.	Favorable------	Slope, erodes easily.
Adena----------	Slope, seepage.	Low strength, piping.	Slope, percs slowly.	Slope, percs slowly.	Slope, piping.	Slope, percs slowly.
19---------- Colombo	Seepage---------	Low strength, compressible.	Floods---------	Favorable------	Erodes easily	Erodes easily.

See footnote at end of table.

TABLE 9.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
20---------- Colombo	Seepage--------	Low strength, compressible.	Floods, slope.	Slope, erodes easily.	Erodes easily	Erodes easily.
21, 22---------- Dacono	Seepage--------	Shrink-swell, seepage, piping.	Slope, percs slowly.	Slow intake, slope.	Percs slowly---	Percs slowly.
23---------- Fort Collins	Seepage--------	Low strength---	Percs slowly---	Favorable------	Favorable------	Favorable.
24---------- Fort Collins	Slope, seepage.	Low strength---	Slope, percs slowly.	Slope----------	Favorable------	Favorable.
25---------- Haverson	Seepage--------	Low strength, compressible, piping.	Floods---------	Floods---------	Floods, piping.	Favorable.
26---------- Haverson	Seepage--------	Low strength, compressible, piping.	Slope----------	Slope----------	Floods, piping.	Favorable.
27, 28---------- Heldt	Slope----------	Low strength, shrink-swell.	Percs slowly, slope.	Slope, percs slowly, slow intake.	Percs slowly---	Percs slowly.
29---------- Julesburg	Seepage--------	Seepage, piping, low strength.	Favorable------	Droughty-------	Soil blowing, piping.	Erodes easily.
30---------- Julesburg	Seepage, slope.	Seepage, piping, low strength.	Slope----------	Droughty, slope, erodes easily.	Soil blowing, piping.	Erodes easily.
31---------- Kim	Seepage, slope.	Piping, low strength, hard to pack.	Favorable------	Favorable------	Slope, piping.	Slope.
32, 33, 34-------- Kim	Seepage, slope.	Piping, low strength, hard to pack.	Slope----------	Slope----------	Slope, piping.	Slope.
35*:						
Loup----------	Seepage--------	Seepage, piping.	Poor outlets, cutbanks cave.	Wetness, seepage.	Wetness--------	Wetness.
Boel----------	Seepage--------	Seepage, erodes easily, piping.	Wetness, floods, poor outlets.	Fast intake, seepage, wetness.	Wetness, too sandy.	Wetness, floods.
36*:						
Midway----------	Slope, depth to rock, seepage.	Thin layer, shrink-swell, low strength.	Complex slope, depth to rock, excess salt.	Complex slope, rooting depth, excess salt.	Slope, depth to rock, poor outlets.	Slope, percs slowly, excess salt.
Shingle----------	Slope, depth to rock.	Low strength, thin layer.	Depth to rock, slope.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
37---------- Nelson	Depth to rock, seepage.	Piping, thin layer, low strength.	Slope, depth to rock.	Slope, rooting depth.	Depth to rock	Rooting depth.
38---------- Nelson	Slope, depth to rock, seepage.	Piping, thin layer, low strength.	Slope, depth to rock.	Slope, rooting depth.	Slope, depth to rock.	Slope, rooting depth.
39---------- Nunn	Favorable------	Compressible, shrink-swell, hard to pack.	Percs slowly---	Percs slowly---	Percs slowly---	Favorable.

See footnote at end of table.

TABLE 9.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
40---------- Nunn	Favorable------	Compressible, shrink-swell, hard to pack.	Percs slowly, slope.	Percs slowly, slope.	Percs slowly---	Favorable.
41---------- Nunn	Favorable------	Compressible, shrink-swell, hard to pack.	Percs slowly---	Percs slowly---	Percs slowly---	Favorable.
42---------- Nunn	Favorable------	Compressible, shrink-swell, hard to pack.	Percs slowly, slope.	Percs slowly, slope.	Percs slowly---	Favorable.
43---------- Nunn	Favorable------	Compressible, shrink-swell, hard to pack.	Percs slowly---	Percs slowly---	Percs slowly---	Favorable.
44---------- Olney	Seepage, slope.	Piping, low strength.	Slope----------	Soil blowing, droughty.	Erodes easily, piping.	Erodes easily.
45---------- Olney	Seepage, slope.	Piping, low strength.	Slope----------	Soil blowing, droughty, slope.	Erodes easily, piping.	Erodes easily.
46---------- Olney	Seepage, slope.	Piping, low strength.	Favorable------	Favorable------	Erodes easily, piping.	Erodes easily.
47, 48------ Olney	Seepage, slope.	Piping, low strength.	Slope----------	Slope, erodes easily.	Erodes easily, piping.	Erodes easily.
49---------- Osgood	Seepage--------	Piping---------	Favorable------	Soil blowing---	Too sandy, piping.	Erodes easily.
50---------- Otero	Seepage--------	Piping, seepage.	Favorable------	Droughty-------	Erodes easily, piping.	Erodes easily.
51, 52, 53-------- Otero	Seepage, slope.	Piping, seepage.	Slope----------	Slope, erodes easily, droughty.	Erodes easily, piping.	Erodes easily.
54---------- Paoli	Seepage--------	Piping, low strength.	Favorable------	Favorable------	Piping---------	Favorable.
55---------- Paoli	Seepage--------	Piping, low strength.	Slope----------	Slope----------	Piping---------	Favorable.
56---------- Renohill	Depth to rock	Low strength, thin layer, compressible.	Depth to rock, percs slowly.	Rooting depth, slow intake.	Depth to rock, percs slowly.	Rooting depth, percs slowly.
57---------- Renohill	Slope, depth to rock.	Low strength, thin layer, compressible.	Slope, depth to rock, percs slowly.	Slope, rooting depth, slow intake.	Depth to rock, percs slowly.	Rooting depth, percs slowly.
58, 59------ Shingle	Slope, depth to rock.	Low strength, thin layer.	Depth to rock, slope.	Slope, rooting depth.	Depth to rock	Rooting depth.
60*: Shingle----------	Slope, depth to rock.	Low strength, thin layer.	Depth to rock, slope.	Slope, rooting depth.	Depth to rock	Rooting depth.
Renohill---------	Slope, depth to rock.	Low strength, thin layer, compressible.	Slope, depth to rock, percs slowly.	Slope, rooting depth, slow intake.	Depth to rock, percs slowly.	Rooting depth, percs slowly.
61---------- Tassel	Depth to rock, slope.	Erodes easily, thin layer.	Not needed-----	Droughty, rooting depth.	Depth to rock, erodes easily.	Rooting depth, erodes easily.
62---------- Terry	Depth to rock, seepage.	Piping, thin layer.	Slope, rooting depth.	Slope, rooting depth, soil blowing.	Depth to rock, piping, soil blowing.	Rooting depth, soil blowing.

See footnote at end of table.

TABLE 9.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
63---------- Terry	Slope, depth to rock, seepage.	Piping, thin layer.	Slope, rooting depth.	Slope, rooting depth, soil blowing.	Slope, depth to rock, soil blowing.	Slope, rooting depth, soil blowing.
64---------- Thedalund	Depth to rock, slope.	Low strength, piping, thin layer.	Slope, depth to rock.	Slope, rooting depth.	Depth to rock	Rooting depth.
65---------- Thedalund	Depth to rock, slope.	Low strength, piping, thin layer.	Slope, depth to rock.	Slope, rooting depth.	Depth to rock	Slope, rooting depth.
66---------- Ulm	Favorable------	Low strength, shrink-swell, compressible.	Favorable------	Percs slowly, erodes easily.	Percs slowly---	Erodes easily.
67---------- Ulm	Slope----------	Low strength, shrink-swell, compressible.	Slope----------	Slope, percs slowly, erodes easily.	Percs slowly---	Erodes easily.
68*---------- Ustic Torriorthents	Seepage, slope.	Seepage--------	Slope----------	Slope, droughty.	Too sandy, slope.	Droughty, slope.
69---------- Valent	Seepage, slope.	Piping, seepage.	Slope----------	Slope, erodes easily, droughty.	Erodes easily, piping.	Erodes easily.
70---------- Valent	Seepage, slope.	Piping, seepage.	Slope----------	Slope, erodes easily, droughty.	Erodes easily, piping.	Slope, erodes easily.
71*: Valent----------	Seepage, slope.	Piping, seepage.	Slope----------	Slope, erodes easily, droughty.	Erodes easily, piping.	Slope, erodes easily.
Loup----------	Seepage--------	Seepage, piping.	Poor outlets, cutbanks cave.	Wetness, seepage.	Not needed-----	Not needed.
72, 73---------- Vona	Seepage, slope.	Piping, erodes easily, seepage.	Slope----------	Slope, fast intake, seepage.	Piping, erodes easily.	Erodes easily.
74---------- Vona	Seepage, slope.	Piping, erodes easily, seepage.	Slope----------	Slope, fast intake, seepage.	Piping, erodes easily.	Slope, erodes easily.
75---------- Vona	Seepage, slope.	Piping, erodes easily, seepage.	Favorable------	Fast intake, seepage.	Piping, erodes easily.	Erodes easily.
76, 77---------- Vona	Seepage, slope.	Piping, erodes easily, seepage.	Slope----------	Slope, fast intake, seepage.	Piping, erodes easily.	Erodes easily.
78---------- Weld	Seepage--------	Low strength---	Percs slowly---	Percs slowly, slow intake.	Piping, percs slowly.	Percs slowly.
79, 80---------- Weld	Seepage--------	Low strength---	Slope, percs slowly.	Slope, percs slowly, slow intake.	Piping, percs slowly.	Percs slowly.
81*: Wiley----------	Slope, seepage.	Piping, low strength.	Percs slowly---	Favorable------	Piping---------	Erodes easily.
Colby----------	Seepage--------	Low strength, piping.	Favorable------	Favorable------	Favorable------	Favorable.

See footnote at end of table.

TABLE 9.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
82*:						
Wiley	Slope, seepage.	Piping, low strength.	Slope, percs slowly.	Slope, erodes easily.	Piping	Erodes easily.
Colby	Seepage	Low strength, piping.	Favorable	Favorable	Favorable	Slope, erodes easily.
83*:						
Wiley	Slope, seepage.	Piping, low strength.	Slope, percs slowly.	Slope, erodes easily.	Piping	Slope, erodes easily.
Colby	Seepage	Low strength, piping.	Slope	Slope, erodes easily.	Favorable	Slope, erodes easily.

* See map unit description for the composition and behavior of the map unit.

TABLE 10.--RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1---------- Altvan	Slight----------	Slight----------	Slight----------	Slight.
2---------- Altvan	Slight----------	Slight----------	Moderate: slope.	Slight.
3*: Aquolls----------	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Aquents----------	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
4*: Aquolls----------	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
Aquepts----------	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.	Severe: wetness, floods.
5, 6---------- Ascalon	Slight----------	Slight----------	Moderate: slope.	Slight.
7---------- Ascalon	Slight----------	Slight----------	Severe: slope.	Slight.
8---------- Ascalon	Slight----------	Slight----------	Slight----------	Slight.
9---------- Ascalon	Slight----------	Slight----------	Moderate: slope.	Slight.
10---------- Bankard	Severe: floods.	Moderate: floods, too sandy.	Severe: floods.	Slight.
11---------- Bresser	Slight----------	Slight----------	Slight----------	Slight.
12---------- Bresser	Slight----------	Slight----------	Moderate: slope.	Slight.
13---------- Cascajo	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Moderate: small stones.
14---------- Colby	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
15, 16---------- Colby	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
17---------- Colby	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
18*: Colby----------	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
18*: Adena	Moderate: percs slowly, dusty.	Moderate: dusty.	Moderate: dusty, slope.	Moderate: dusty.
19--- Colombo	Severe: floods.	Moderate: floods.	Moderate: floods.	Slight.
20--- Colombo	Slight	Slight	Moderate: slope.	Slight.
21--- Dacono	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.
22--- Dacono	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
23--- Fort Collins	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
24--- Fort Collins	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, slope.	Moderate: dusty.
25, 26--- Haverson	Severe: floods.	Moderate: floods.	Severe: floods.	Slight.
27, 28--- Heldt	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
29--- Julesburg	Slight	Slight	Slight	Slight.
30--- Julesburg	Slight	Slight	Moderate: slope.	Slight.
31--- Kim	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
32, 33--- Kim	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
34--- Kim	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
35*: Loup	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.
Boel	Severe: wetness, floods.	Moderate: wetness, floods.	Moderate: wetness, floods.	Moderate: wetness, floods.
36*: Midway	Severe: too clayey, percs slowly.	Severe: too clayey.	Severe: slope, too clayey, depth to rock.	Severe: too clayey.
Shingle	Moderate: too clayey.	Moderate: slope, too clayey.	Severe: slope, depth to rock.	Moderate: too clayey.
37--- Nelson	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
38---------- Nelson	Slight----------	Slight----------	Severe: slope.	Slight.
39---------- Nunn	Moderate: percs slowly.	Slight----------	Moderate: percs slowly.	Slight.
40---------- Nunn	Moderate: percs slowly.	Slight----------	Moderate: percs slowly, slope.	Slight.
41---------- Nunn	Moderate: percs slowly.	Moderate: too clayey.	Moderate: percs slowly.	Moderate: too clayey.
42---------- Nunn	Moderate: percs slowly.	Moderate: too clayey.	Moderate: percs slowly, slope.	Moderate: too clayey.
43---------- Nunn	Moderate: percs slowly.	Moderate: too sandy.	Moderate: percs slowly.	Moderate: too sandy.
44, 45---------- Olney	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.	Moderate: too sandy, slope, dusty.	Moderate: too sandy, dusty.
46---------- Olney	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
47, 48---------- Olney	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, slope.	Moderate: dusty.
49---------- Osgood	Moderate: too sandy.	Moderate: too sandy.	Severe: too sandy.	Moderate: too sandy.
50---------- Otero	Slight----------	Slight----------	Slight----------	Slight.
51, 52---------- Otero	Slight----------	Slight----------	Moderate: slope.	Slight.
53---------- Otero	Slight----------	Slight----------	Severe: slope.	Slight.
54---------- Paoli	Slight----------	Slight----------	Slight----------	Slight.
55---------- Paoli	Slight----------	Slight----------	Moderate: slope.	Slight.
56---------- Renohill	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
57---------- Renohill	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
58, 59---------- Shingle	Moderate: too clayey.	Moderate: too clayey.	Severe: depth to rock.	Moderate: too clayey.
60*: Shingle----------	Moderate: too clayey.	Moderate: too clayey.	Severe: slope, depth to rock.	Moderate: too clayey.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
60*:				
Renohill	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
61--- Tassel	Moderate: slope.	Moderate: slope.	Severe: depth to rock, slope.	Slight.
62--- Terry	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, depth to rock.	Moderate: dusty.
63--- Terry	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Moderate: dusty.
64--- Thedalund	Moderate: dusty.	Moderate: dusty.	Moderate: slope, depth to rock, dusty.	Slight.
65--- Thedalund	Moderate: dusty.	Moderate: dusty.	Severe: slope.	Slight.
66--- Ulm	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: percs slowly.	Moderate: too clayey.
67--- Ulm	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Moderate: percs slowly, too clayey, slope.	Moderate: too clayey.
68*--- Ustic Torriorthents	Severe: small stones, too sandy.	Severe: small stones, too sandy.	Severe: slope, small stones, too sandy.	Severe: small stones, too sandy.
69--- Valent	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.	Severe: too sandy.	Severe: too sandy.
70--- Valent	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.	Severe: too sandy, slope.	Severe: too sandy.
71*:				
Valent	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.	Severe: too sandy, slope.	Severe: too sandy.
Loup	Severe: wetness, floods.	Severe: wetness.	Severe: wetness.	Severe: wetness.
72--- Vona	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.
73--- Vona	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.	Moderate: too sandy, slope, dusty.	Moderate: too sandy, dusty.
74--- Vona	Moderate: too sandy, dusty.	Moderate: too sandy, dusty.	Severe: slope.	Moderate: too sandy, dusty.

See footnote at end of table.

TABLE 10.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
75---------- Vona	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
76, 77---------- Vona	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.
78---------- Weld	Moderate: percs slowly.	Slight----------	Moderate: percs slowly.	Slight.
79, 80---------- Weld	Moderate: percs slowly.	Slight----------	Moderate: percs slowly, slope.	Slight.
81*: Wiley----------	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
Colby----------	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
82*, 83*: Wiley----------	Moderate: dusty.	Moderate: dusty.	Moderate: dusty, slope.	Moderate: dusty.
Colby----------	Moderate: dusty.	Moderate: dusty.	Moderate: slope, dusty.	Moderate: dusty.

* See map unit description for the composition and behavior of the map unit.

TABLE 11.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed-crops**	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1, 2---------- Altvan	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
3*:									
Aquolls----------	Poor	Poor	Good	Fair	Good	Good	Fair	Good	Fair.
Aquents----------	Poor	Poor	Good	Fair	Good	Good	Fair	Good	Fair.
4*:									
Aquolls----------	Poor	Poor	Good	Poor	Good	Good	Fair	Good	Fair.
Aquepts----------	Poor	Poor	Good	Poor	Good	Good	Fair	Good	Fair.
5, 6---------- Ascalon	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
7---------- Ascalon	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
8, 9---------- Ascalon	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
10---------- Bankard	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
11, 12---------- Bresser	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
13---------- Cascajo	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
14, 15---------- Colby	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
16, 17---------- Colby	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
18*:									
Colby----------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Adena----------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
19, 20---------- Colombo	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
21, 22---------- Dacono	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
23, 24---------- Fort Collins	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
25, 26---------- Haverson	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
27---------- Heldt	Fair	Fair	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
28---------- Heldt	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
29---------- Julesburg	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
30---------- Julesburg	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.

See footnotes at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops**	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
31, 32---------- Kim	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
33, 34---------- Kim	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
35*:									
Loup----------	Poor	Fair	Good	Fair	Good	Good	Fair	Good	Fair.
Boel----------	Poor	Fair	Good	Fair	Good	Good	Fair	Good	Fair.
36*:									
Midway----------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Shingle----------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
37, 38---------- Nelson	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
39, 40, 41, 42, 43- Nunn	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
44, 45---------- Olney	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
46, 47---------- Olney	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
48---------- Olney	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
49---------- Osgood	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
50---------- Otero	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
51, 52, 53--------- Otero	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
54, 55---------- Paoli	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
56, 57---------- Renohill	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
58, 59---------- Shingle	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
60*:									
Shingle----------	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
Renohill----------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
61---------- Tassel	Poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
62, 63---------- Terry	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
64, 65---------- Thedalund	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
66---------- Ulm	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
67---------- Ulm	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 11.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops**	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
68*---------- Ustic Torriorthents	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
69, 70---------- Valent	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
71*:									
Valent----------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Loup----------	Poor	Fair	Good	Fair	Good	Good	Fair	Good	Fair.
72, 73---------- Vona	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
74---------- Vona	Poor	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
75, 76---------- Vona	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
77---------- Vona	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
78, 79---------- Weld	Good	Good	Fair	Poor	Poor	Very poor	Good	Very poor	Poor.
80---------- Weld	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
81*, 82*:									
Wiley----------	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Poor.
Colby----------	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
83*:									
Wiley----------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Colby----------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.

* See map unit description for the composition and behavior of the map unit.

** Potential for grain and seed crops, grasses and legumes, and for openland wildlife based on irrigated land use.

TABLE 12.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1, 2	0-10	Loam	CL-ML	A-4	0	90-100	85-100	60-95	50-75	20-30	5-10
Altvan	10-25	Clay loam, loam	CL	A-6, A-7	0	95-100	95-100	85-100	70-80	35-50	15-25
	25-60	Sand and gravel	SP, SP-SM	A-1	0	75-95	70-90	25-35	0-10	---	NP
3*:											
Aquolls	0-48	Variable	---	---	---	---	---	---	---	---	---
	48-60	Sand, gravelly sand.	SP, SP-SM	A-1	0-10	60-90	50-70	30-50	0-10	---	NP
Aquents	0-48	Variable	---	---	---	---	---	---	---	---	---
	48-60	Sand and gravel	SP, SP-SM	A-1	0-10	60-90	50-70	30-50	0-10	---	NP
4*:											
Aquolls	0-60	Variable	---	---	---	---	---	---	---	---	---
Aquepts	0-60	Variable	---	---	---	---	---	---	---	---	---
5, 6, 7	0-8	Sandy loam	SM	A-2, A-4	0	95-100	90-100	70-95	25-50	15-25	NP-5
Ascalon	8-18	Sandy clay loam	SC, CL	A-6	0	95-100	90-100	80-100	40-55	20-40	10-20
	18-60	Sandy loam, sandy clay loam, fine sandy loam.	SC, SM-SC, CL, CL-ML	A-4, A-6	0	95-100	95-100	75-95	35-65	20-40	5-15
8, 9	0-8	Loam	SM	A-2, A-4	0	95-100	90-100	70-95	25-50	15-25	NP-5
Ascalon	8-18	Sandy clay loam	SC, CL	A-6	0	95-100	90-100	80-100	40-55	20-40	10-20
	18-60	Sandy loam, sandy clay loam, fine sandy loam.	SC, SM-SC, CL, CL-ML	A-4, A-6	0	95-100	95-100	75-95	35-65	20-40	5-15
10	0-4	Sandy loam	SM	A-2, A-4	0	95-100	90-100	60-70	30-40	---	NP
Bankard	4-60	Fine sand, sand, gravelly sand.	SP-SM, SM	A-2, A-3, A-1	0-5	70-100	60-100	40-70	5-25	---	NP
11, 12	0-16	Sandy loam	SM	A-1, A-2	0	95-100	75-100	35-50	20-35	15-25	NP-5
Bresser	16-25	Sandy clay loam	SC	A-2, A-6, A-7	0	95-100	75-100	50-70	30-50	30-55	10-25
	25-30	Sandy loam, coarse sandy loam, gravelly sandy loam.	SC, SM-SC	A-2, A-1	0	90-100	60-100	30-60	20-30	25-35	5-15
	30-60	Loamy coarse sand, gravelly loamy sand, very gravelly loamy sand.	SP-SC	A-2, A-1	0-5	80-100	35-85	20-50	5-10	20-30	5-10
13	0-9	Gravelly sandy loam.	GM	A-1, A-2	0-15	50-65	50-60	15-40	10-35	---	NP
Cascajo	9-31	Very gravelly sandy loam, very gravelly loamy sand, very gravelly sand.	GP-GM, GP, GM	A-1	0-15	15-50	15-50	5-30	0-20	---	NP
	31-60	Very gravelly loamy sand, very gravelly sand, gravelly sand.	GP, SP, GP-GM, SP-SM	A-1	0-15	10-60	10-60	5-30	0-10	---	NP

See footnote at end of table.

TABLE 12.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
14, 15, 16, 17----- Colby	0-7	Loam----------	CL-ML	A-4	0	100	100	90-100	85-100	25-30	5-10
	7-60	Silt loam, loam, very fine sandy loam.	CL-ML	A-4	0	100	100	90-100	85-100	25-30	5-10
18*:											
Colby----------	0-7	Loam----------	CL-ML	A-4	0	100	100	90-100	85-100	25-30	5-10
	7-60	Silt loam, loam, very fine sandy loam.	CL-ML	A-4	0	100	100	90-100	85-100	25-30	5-10
Adena----------	0-6	Loam----------	ML	A-4	0	100	100	90-100	70-90	20-30	NP-5
	6-9	Clay, clay loam, silty clay loam.	CH, CL	A-6, A-7	0	100	100	95-100	80-90	35-60	15-35
	9-60	Loam, silt loam, very fine sandy loam.	ML	A-4	0	100	100	90-100	75-90	20-30	NP-5
19, 20---------- Colombo	0-14	Clay loam-------	CL-ML	A-4	0	95-100	80-100	75-90	50-70	25-30	5-10
	14-21	Clay loam, loam	CL	A-6	0	95-100	75-100	75-90	50-70	20-30	10-15
	21-60	Stratified clay loam to sand.	CL, CL-ML	A-4, A-6	0-5	90-100	75-100	70-90	50-60	20-30	5-15
21, 22---------- Dacono	0-12	Clay loam-------	CL, CL-ML	A-6, A-4	0	85-100	75-100	75-95	70-80	20-40	5-20
	12-21	Clay loam, clay, gravelly clay loam.	CL	A-6, A-7	0	75-100	60-100	55-95	50-85	35-45	15-20
	21-27	Sandy clay loam, loam, silt loam.	CL, SC	A-6	0	75-100	60-100	50-95	40-85	25-40	10-20
	27-60	Very gravelly sand.	SP, GP	A-1	0	35-80	5-50	5-40	0-5	---	NP
23, 24---------- Fort Collins	0-7	Loam----------	CL-ML	A-4	0	95-100	90-100	85-100	50-65	25-30	5-10
	7-11	Loam, clay loam	CL	A-6	0	95-100	90-100	85-95	60-75	25-40	15-25
	11-60	Loam, fine sandy loam.	CL, CL-ML	A-4, A-6	0	95-100	90-100	80-95	50-75	25-35	5-15
25, 26---------- Haverson	0-4	Loam----------	ML, CL-ML	A-4	0	95-100	80-100	75-90	50-60	20-30	NP-10
	4-60	Stratified clay loam to sand.	ML, CL-ML	A-4	0	95-100	75-100	75-90	50-60	20-30	NP-10
27, 28---------- Heldt	0-60	Silty clay------	CH, CL	A-7	0	95-100	95-100	95-100	75-95	45-55	25-35
29, 30---------- Julesburg	0-12	Sandy loam------	SM, ML	A-2, A-4	0	95-100	75-100	45-85	25-55	---	NP
	12-27	Fine sandy loam, sandy loam.	SM, ML	A-2, A-4	0	95-100	75-100	50-85	30-55	15-25	NP-5
	27-60	Sandy loam, loamy sand, fine sand.	SM	A-2, A-4, A-1	0	95-100	75-100	40-85	15-50	---	NP
31, 32, 33, 34----- Kim	0-12	Loam----------	ML, SM	A-4	0-5	80-100	75-100	60-90	45-75	20-35	NP-5
	12-40	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	80-100	75-100	70-95	60-85	25-40	5-15
	40-60	Fine sandy loam	SM, ML	A-4	0-5	80-100	75-100	70-95	40-55	20-30	NP-5
35*:											
Loup----------	0-16	Loamy sand------	SM	A-2	0	100	100	50-100	15-30	---	NP
	16-60	Loamy sand, sand	SP-SM, SM	A-2, A-3	0	100	100	65-100	5-20	---	NP
Boel----------	0-14	Loamy sand------	SM	A-2	0	100	100	85-95	20-35	---	NP
	14-60	Fine sand, loamy fine sand, coarse sand.	SP, SM, SP-SM	A-2, A-3	0	100	100	85-95	0-25	---	NP
36*:											
Midway----------	0-13	Clay----------	CL, CH	A-7	0	100	100	90-100	80-95	45-60	20-35
	13	Weathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
36*:											
Shingle	0-6	Loam	CL-ML	A-4	0-5	75-100	75-100	70-95	55-75	25-35	5-10
	6-18	Clay loam, loam	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
37, 38	0-9	Fine sandy loam	ML, SM	A-4	0-5	75-100	75-100	70-90	45-60	---	NP
Nelson	9-30	Fine sandy loam, sandy loam.	SM, ML	A-4, A-2	0	75-100	75-100	60-85	30-55	---	NP
	30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
39, 40	0-9	Loam	CL, SC	A-6	0-5	95-100	80-95	70-95	45-75	25-40	10-20
Nunn	9-29	Clay loam, clay	CL, CH	A-6, A-7	0-5	95-100	90-100	85-95	65-75	35-60	20-35
	29-60	Clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-2	0-5	80-100	80-100	60-90	25-75	15-40	5-20
41, 42	0-9	Clay loam	CL, SC	A-6	0-5	95-100	80-95	70-95	45-75	25-40	10-20
Nunn	9-29	Clay loam, clay	CH	A-6, A-7	0-5	95-100	90-100	85-95	65-75	35-60	20-35
	29-60	Clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-2	0-5	80-100	80-100	60-90	25-75	15-40	5-20
43	0-9	Loamy sand	SM	A-2	0-5	95-100	80-95	60-80	20-30	---	NP
Nunn	9-30	Clay loam, clay	CL, CH	A-6, A-7	0-5	95-100	90-100	85-95	65-75	35-60	20-35
	30-60	Clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-2	0-5	80-100	80-100	60-90	25-75	15-40	5-20
44, 45	0-10	Loamy sand	SM	A-2	0	95-100	90-100	60-90	15-25	---	NP
Olney	10-20	Sandy clay loam	SC, CL	A-6	0	95-100	90-100	80-100	40-55	20-40	10-20
	20-25	Sandy loam, sandy clay loam, fine sandy loam.	SC, SM-SC, CL, CL-ML	A-4, A-6	0	95-100	95-100	75-95	35-55	20-35	5-15
	25-60	Fine sandy loam, loamy fine sand.	SM	A-2	0	95-100	95-100	70-95	20-35	---	NP
46, 47, 48	0-10	Fine sandy loam	SM	A-2	0	95-100	90-100	70-95	20-35	15-25	NP-5
Olney	10-20	Sandy clay loam	SC, CL	A-6	0	95-100	90-100	80-100	40-55	20-40	10-20
	20-25	Sandy loam, sandy clay loam, fine sandy loam.	SC, SM-SC, CL, CL-ML	A-4, A-6	0	95-100	95-100	75-95	35-55	20-35	5-15
	25-60	Fine sandy loam, loamy fine sand.	SM	A-2	0	95-100	95-100	70-95	20-35	---	NP
49	0-22	Sand	SM	A-2	0	100	100	65-80	15-30	---	NP
Osgood	22-34	Sandy loam	SM	A-2, A-4	0	100	100	60-80	30-40	---	NP
	34-60	Loamy sand, sand	SM	A-2	0	100	95-100	50-75	10-25	---	NP
50, 51, 52, 53	0-12	Sandy loam	SM	A-2	0-1	95-100	75-100	50-80	20-35	---	NP
Otero	12-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-1	0-1	90-100	50-100	40-80	20-35	---	NP
54, 55	0-20	Loam	ML	A-4	0	95-100	90-100	75-95	55-75	25-35	NP-5
Paoli	20-25	Fine sandy loam, sandy loam.	SM	A-4	0	80-100	80-100	60-85	35-50	---	NP
	25-60	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	75-100	75-100	55-85	30-50	---	NP

See footnote at end of table.

TABLE 12.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
56, 57----------	0-9	Clay loam-------	CL	A-6	0	85-100	80-100	80-95	70-80	25-40	10-20
Renohill	9-32	Clay, clay loam	CL, CH	A-7, A-6	0	95-100	90-100	90-100	75-95	35-65	20-35
	32	Weathered bedrock.	---	---	---	---	---	---	---	---	---
58, 59----------	0-6	Loam----------	CL-ML	A-4	0-5	75-100	75-100	70-95	55-75	25-35	5-10
Shingle	6-18	Clay loam, loam	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
60*:											
Shingle----------	0-6	Loam----------	CL-ML	A-4	0-5	75-100	75-100	70-95	55-75	25-35	5-10
	6-18	Clay loam, loam	CL	A-6	0	75-100	75-100	65-100	50-80	30-40	10-20
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Renohill----------	0-9	Clay loam-------	CL	A-6	0	85-100	80-100	80-95	70-80	25-40	10-20
	9-32	Clay, clay loam	CL, CH	A-7, A-6	0	95-100	90-100	90-100	75-95	35-65	20-35
	32	Weathered bedrock.	---	---	---	---	---	---	---	---	---
61----------	0-11	Fine sandy loam	ML, SM	A-4	0	95-100	90-100	70-95	40-65	20-35	NP-5
Tassel	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
62, 63----------	0-6	Fine sandy loam	SM, ML	A-2, A-4	0-5	75-100	75-100	70-90	30-60	---	NP
Terry	6-18	Fine sandy loam, sandy loam.	SM, ML	A-4	0	75-100	75-100	70-85	40-60	---	NP
	18-37	Fine sandy loam, sandy loam, loamy fine sand.	SM	A-2, A-4	0-5	75-100	75-100	70-85	25-50	---	NP
	37	Weathered bedrock.	---	---	---	---	---	---	---	---	---
64, 65----------	0-8	Loam----------	CL-ML	A-4	0-5	80-100	75-100	70-95	50-75	20-30	5-10
Thedalund	8-25	Clay loam, loam, very fine sandy loam.	CL-ML, CL, SM-SC, SC	A-6, A-4	0-5	80-100	75-100	70-95	40-80	25-35	5-15
	25	Weathered bedrock.	---	---	---	---	---	---	---	---	---
66, 67----------	0-5	Clay loam-------	CL	A-6	0-5	95-100	95-100	80-100	70-80	30-40	10-15
Ulm	5-19	Clay loam, clay	CL	A-6, A-7	0-5	75-100	75-100	75-100	60-80	35-45	20-30
	19-60	Clay loam-------	CL	A-6	0-5	75-100	75-100	75-100	60-80	30-40	15-20
68*----------	0-60	Variable--------	---	---	---	---	---	---	---	---	---
Ustic Torriorthents											
69, 70----------	0-8	Fine sand-------	SM	A-2	0	100	100	80-95	10-30	---	NP
Valent	8-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	95-100	75-90	5-20	---	NP
71*:											
Valent----------	0-8	Fine sand-------	SM,	A-2	0	100	100	80-95	10-30	---	NP
	8-60	Fine sand, sand	SP-SM, SM	A-2, A-3	0	100	95-100	75-90	5-20	---	NP
Loup----------	0-16	Loamy sand------	SM	A-2	0	100	100	50-100	15-30	---	NP
	16-60	Fine sand, loamy sand, sand.	SP-SM, SM	A-2, A-3	0	100	100	65-100	5-20	---	NP

See footnote at end of table.

TABLE 12.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
72, 73, 74----------	0-6	Loamy sand------	SM	A-2	0	100	90-100	60-90	15-30	---	NP
Vona	6-28	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	100	90-100	60-90	30-45	---	NP
	28-60	Sandy loam, loamy sand.	SM	A-2	0	100	90-100	50-85	15-30	---	NP
75, 76, 77----------	0-6	Sandy loam------	SM	A-2, A-4	0	100	90-100	60-90	30-45	---	NP
Vona	6-28	Fine sandy loam, sandy loam.	SM	A-2, A-4	0	100	90-100	60-90	30-45	---	NP
	28-60	Sandy loam, loamy sand.	SM	A-2	0	100	90-100	50-85	15-30	---	NP
78, 79, 80----------	0-8	Loam------------	ML, CL-ML	A-4	0	100	95-100	85-100	60-85	20-30	NP-10
Weld	8-15	Silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	95-100	85-95	35-50	15-30
	15-60	Silt loam, loam	CL-ML, CL	A-4, A-6	0	100	95-100	85-100	60-85	20-35	5-15
81*, 82*, 83*:											
Wiley----------	0-11	Silt loam-------	CL-ML, CL	A-4, A-6	0	100	100	90-100	70-90	25-35	5-15
	11-60	Silty clay loam, silt loam.	CL	A-6	0	100	100	90-100	70-95	25-35	10-20
Colby----------	0-7	Loam------------	CL-ML	A-4	0	100	100	90-100	85-100	25-30	5-10
	7-60	Silt loam, loam	CL-ML	A-4	0	100	100	90-100	85-100	25-30	5-10

* See map unit description for the composition and behavior of the map unit.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means greater then. The erosion tolerance factor (T) is for the entire profile. Absence of an entry means data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
							Uncoated steel	Concrete	K	T	
	In	In/hr	In/in	pH	Mmhos/cm						
1, 2	0-10	0.6-2.0	0.20-0.24	6.6-7.8	---	Low	Moderate	Low	0.24	3	5
Altvan	10-25	0.6-2.0	0.15-0.17	7.4-8.4	<2	Moderate	Moderate	Low	0.28		
	25-60	>20	0.02-0.04	7.4-9.0	<2	Low	Moderate	Low	0.10		
3*:											
Aquolls	0-48	---	---	---	---	---	---	---	---	---	---
	48-60	>20	0.04-0.06	7.4-8.4	2-16	Low	High	Moderate	---		
Aquents	0-48	---	---	---	---	---	---	---	---	---	---
	48-60	>20	0.04-0.06	7.4-8.4	2-16	Low	High	Moderate	---		
4*:											
Aquolls	0-60	---	---	---	---	---	---	---	---	---	---
Aquepts	0-60	---	---	---	---	---	---	---	---	---	---
5, 6, 7, 8, 9	0-8	0.6-6.0	0.11-0.16	6.6-7.8	<2	Low	Low	Low	0.17	5	3
Ascalon	8-18	0.6-2.0	0.13-0.15	6.6-7.8	<2	Moderate	Moderate	Low	0.24		
	18-60	0.6-6.0	0.11-0.15	7.9-8.4	<2	Low	Moderate	Low	0.24		
10	0-4	2.0-6.0	0.09-0.12	7.4-8.4	<2	Low	Moderate	Low	0.10	5	3
Bankard	4-60	6.0-20	0.05-0.08	7.4-8.4	<2	Low	Moderate	Low	0.10		
11, 12	0-16	0.6-6.0	0.11-0.13	6.1-7.3	---	Low	Low	Low	0.10	5	2
Bresser	16-25	0.6-2.0	0.15-0.18	6.6-7.3	---	Low	Moderate	Low	0.15		
	25-30	0.6-6.0	0.10-0.13	6.6-7.3	---	Low	Low	Low	0.10		
	30-60	2.0-20	0.05-0.08	6.6-7.3	---	Low	Low	Low	0.10		
13	0-9	2.0-6.0	0.07-0.09	7.4-8.4	<2	Low	Moderate	Low	0.10	5	8
Cascajo	9-31	6.0-20	0.05-0.08	7.4-8.4	<2	Low	Moderate	Low	0.10		
	31-60	6.0-20	0.05-0.06	7.4-8.4	<2	Low	Moderate	Low	0.10		
14, 15, 16, 17	0-7	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low	Moderate	Low	0.37	5	4L
Colby	7-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low	Moderate	Low	0.37		
18*:											
Colby	0-7	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low	Moderate	Low	0.37	5	4L
	7-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low	Moderate	Low	0.37		
Adena	0-6	0.6-2.0	0.18-0.21	6.6-7.8	<2	Low	Moderate	Low	0.37	5	5
	6-9	0.06-0.2	0.16-0.18	6.6-7.8	<2	High	High	Low	0.24		
	9-60	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low	High	Low	0.32		
19, 20	0-14	0.6-2.0	0.14-0.18	7.4-8.4	<2	Low	High	Low	0.32	5	5
Colombo	14-21	0.6-2.0	0.14-0.16	7.4-8.4	<2	Moderate	High	Low	0.28		
	21-60	0.6-2.0	0.14-0.16	7.4-8.4	<2	Low	High	Low	0.28		
21, 22	0-12	0.2-0.6	0.19-0.21	6.6-7.8	<2	Moderate	Moderate	Low	0.24	3	5
Dacono	12-21	0.2-0.6	0.15-0.21	7.4-8.4	<2	High	High	Low	0.24		
	21-27	0.2-2.0	0.13-0.18	7.4-8.4	<2	Moderate	High	Low	0.15		
	27-60	>20	0.03-0.05	7.4-8.4	<2	Low	High	Low	0.10		
23, 24	0-7	0.6-2.0	0.16-0.20	6.6-7.8	<2	Low	Moderate	Low	0.20	5	6
Fort Collins	7-11	0.6-2.0	0.16-0.18	7.4-7.8	<2	Moderate	Moderate	Low	0.20		
	11-60	0.6-2.0	0.16-0.18	7.4-8.4	<2	Low	High	Low	0.20		
25, 26	0-4	0.6-2.0	0.14-0.18	6.6-8.4	<8	Low	High	Low	0.28	5	4L
Haverson	4-60	0.6-2.0	0.14-0.18	7.4-8.4	<8	Low	High	Low	0.28		
27, 28	0-60	0.06-0.6	0.12-0.17	7.9-9.0	<8	High	High	High	0.28	5	4
Heldt											

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
							Uncoated steel	Concrete	K	T	
	In	In/hr	In/in	pH	Mmhos/cm						
29, 30---------- Julesburg	0-12 12-27 27-60	2.0-20 2.0-20 >6.0	0.11-0.15 0.11-0.15 0.05-0.13	6.6-7.8 6.6-7.8 6.6-7.8	<2 <2 <2	Low------- Low------- Low-------	Moderate Moderate Moderate	Low------ Low------ Low------	0.24 0.24 0.20	5	3
31, 32, 33, 34----- Kim	0-12 12-60	0.6-2.0 0.6-2.0	0.16-0.18 0.15-0.17	7.9-8.4 7.9-8.4	<2 <2	Low------- Low-------	Moderate Moderate	Low------ Low------	0.32 0.32	5	4L
35*: Loup---------- Boel----------	0-16 16-60 0-14 14-60	6.0-20 6.0-20 6.0-20 6.0-20	0.10-0.14 0.06-0.08 0.10-0.12 0.05-0.07	6.6-8.4 7.4-8.4 6.6-8.4 6.6-8.4	<2 <2 <2 <2	Low------- Low------- Low------- Low-------	High----- High----- High----- High-----	Low------ Low------ Low------ Low------	0.17 0.17 0.17 0.17	5 5	2 2
36*: Midway---------- Shingle---------- 37, 38---------- Nelson	0-13 13 0-6 6-18 18 0-9 9-30 30	0.06-0.2 --- 0.6-2.0 0.6-2.0 --- 2.0-6.0 2.0-6.0 ---	0.12-0.17 --- 0.16-0.18 0.16-0.21 --- 0.13-0.15 0.11-0.13 ---	7.9-9.0 --- 7.4-9.0 7.9-9.0 --- 7.9-8.4 7.9-8.4 ---	2-8 --- <2 <2 --- <2 <2 ---	High------ --- Low------- Moderate --- Low------- Low------- ---	High----- --- High----- High----- --- High----- High----- ---	Low------ --- Low------ Low------ --- Low------ Low------ ---	0.43 --- 0.32 0.49 --- 0.20 0.20 ---	1 2 2	4 4L 3
39, 40, 41, 42----- Nunn	0-9 9-29 29-60	0.2-2.0 0.06-0.6 0.2-2.0	0.15-0.20 0.15-0.18 0.10-0.18	6.6-7.8 7.4-8.4 7.4-8.4	<2 <2 <2	Moderate High------ Moderate	Moderate High----- High-----	Low------ Low------ Low------	0.24 0.28 0.24	5	6
43---------- Nunn	0-9 9-29 29-60	2.0-6.0 0.06-0.6 0.2-2.0	0.10-0.14 0.15-0.18 0.10-0.18	6.6-7.8 7.4-8.4 7.4-8.4	<2 <2 <2	Low------- High------ Moderate	Moderate High----- High-----	Low------ Low------ Low------	0.15 0.28 0.24	5	3
44, 45---------- Olney	0-10 10-20 20-25 25-60	6.0-20 0.6-2.0 0.6-6.0 2.0-6.0	0.06-0.10 0.13-0.15 0.11-0.15 0.06-0.13	6.6-7.8 6.6-7.8 7.9-8.4 7.9-8.4	<2 <2 <2 <2	Low------- Moderate Low------- Low-------	Low------ High----- High----- High-----	Low------ Low------ Low------ Low------	0.17 0.24 0.24 0.20	5	2
46, 47, 48--------- Olney	0-10 10-20 20-25 25-60	0.6-6.0 0.6-2.0 0.6-6.0 2.0-6.0	0.11-0.15 0.13-0.15 0.11-0.15 0.06-0.13	6.6-7.8 6.6-7.8 7.9-8.4 7.9-8.4	<2 <2 <2 <2	Low------- Moderate Low------- Low-------	Moderate High----- High----- High-----	Low------ Low------ Low------ Low------	0.20 0.24 0.24 0.20	5	3
49---------- Osgood	0-22 22-34 34-60	6.0-20 2.0-6.0 6.0-20	0.05-0.08 0.10-0.13 0.06-0.08	6.6-7.3 6.6-7.3 6.6-8.4	--- --- <2	Low------- Low------- Low-------	Low------ Low------ Moderate	Low------ Low------ Low------	0.10 0.17 0.10	5	1
50, 51, 52, 53----- Otero	0-12 12-60	6.0-20 6.0-20	0.09-0.13 0.08-0.12	7.4-8.4 7.4-8.4	<2 <4	Low------- Low-------	High----- High-----	Low------ Low------	0.10 0.10	5	2
54, 55---------- Paoli	0-20 20-25 25-60	0.6-2.0 >6.0 >6.0	0.16-0.18 0.14-0.17 0.12-0.14	6.6-7.3 7.4-7.8 7.4-8.4	--- <2 <2	Low------- Low------- Low-------	Moderate High----- High-----	Low------ Low------ Low------	0.20 0.20 0.20	5	5
56, 57---------- Renohill	0-9 9-32 32	0.2-0.6 0.06-0.2 ---	0.17-0.21 0.14-0.16 ---	6.6-7.8 6.6-8.4 ---	<2 <2 ---	Moderate High------ ---	High----- High----- ---	Low------ Low------ ---	0.37 0.32 ---	3	6
58, 59---------- Shingle	0-6 6-18 18	0.6-2.0 0.6-2.0 ---	0.16-0.18 0.16-0.21 ---	7.4-9.0 7.9-9.0 ---	<2 <2 ---	Low------- Moderate ---	High----- High----- ---	Low------ Low------ ---	0.32 0.49 ---	2	4L
60*: Shingle----------	0-6 6-18 18	0.6-2.0 0.6-2.0 ---	0.16-0.18 0.16-0.21 ---	7.4-9.0 7.9-9.0 ---	<2 <2 ---	Low------- Moderate ---	High----- High----- ---	Low------ Low------ ---	0.32 0.49 ---	2	4L

See footnote at end of table.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Risk of corrosion		Erosion factors		Wind erodibility group
							Uncoated steel	Concrete	K	T	
	In	In/hr	In/in	pH	Mmhos/cm						
60*:											
Renohill	0-9	0.2-0.6	0.17-0.21	6.6-7.8	<2	Moderate	High	Low	0.37	3	6
	9-32	0.06-0.2	0.14-0.16	6.6-8.4	<2	High	High	Low	0.32		
	32	---	---	---	---	---	---	---	---		
61	0-11	2.0-6.0	0.16-0.18	7.4-8.4	<2	Low	High	Low	0.24	1	3
Tassel	11	---	---	---	---	---	---	---	---		
62, 63	0-6	2.0-6.0	0.13-0.15	7.0-7.8	<2	Low	Moderate	Low	0.20	2	3
Terry	6-18	2.0-6.0	0.13-0.15	7.0-7.8	<2	Low	Moderate	Low	0.20		
	18-37	2.0-6.0	0.13-0.15	7.9-8.4	<2	Low	High	Low	0.20		
	37	---	---	---	---	---	---	---	---		
64, 65	0-8	0.6-2.0	0.16-0.18	7.9-8.4	<2	Low	High	Low	0.32	2	4L
Thedalund	8-25	0.6-2.0	0.16-0.18	7.9-8.4	<2	Low	High	Low	0.32		
	25	---	---	---	---	---	---	---	---		
66, 67	0-5	0.6-2.0	0.16-0.18	6.6-7.8	---	Low	High	Low	0.32	5	6
Ulm	5-19	0.06-0.2	0.19-0.21	7.4-8.4	<2	High	High	Low	0.37		
	19-60	0.6-2.0	0.19-0.21	7.9-8.4	<2	Moderate	High	Low	0.37		
68*	0-60	---	---	---	---	---	---	---	---		
Ustic Torriorthents											
69, 70	0-8	6.0-20	0.07-0.12	6.6-7.3	---	Low	Low	Low	0.10	5	1
Valent	8-60	6.0-20	0.05-0.10	6.6-7.8	<2	Low	Low	Low	0.10		
71*:											
Valent	0-8	6.0-20	0.07-0.12	6.6-7.3	---	Low	Low	Low	0.10	5	1
	8-60	6.0-20	0.05-0.10	6.6-7.8	<2	Low	Low	Low	0.10		
Loup	0-16	6.0-20	0.10-0.14	6.6-8.4	<2	Low	High	Low	0.17	5	2
	16-60	6.0-20	0.06-0.08	7.4-8.4	<2	Low	High	Low	0.17		
72, 73, 74	0-6	6.0-20	0.09-0.11	6.6-7.3	---	Low	Low	Low	0.10	5	2
Vona	6-28	2.0-6.0	0.12-0.14	6.6-8.4	<4	Low	High	Low	0.10		
	28-60	6.0-20	0.08-0.11	7.4-8.4	<4	Low	High	Low	0.10		
75, 76, 77	0-6	2.0-6.0	0.11-0.13	6.6-7.3	---	Low	Low	Low	0.10	5	3
Vona	6-28	2.0-6.0	0.12-0.14	6.6-8.4	<4	Low	High	Low	0.10		
	28-60	6.0-20	0.08-0.11	7.4-8.4	<4	Low	High	Low	0.10		
78, 79, 80	0-8	0.6-2.0	0.16-0.21	6.6-7.3	<2	Low	Low	Low	0.32	5	6
Weld	8-15	0.06-0.2	0.19-0.21	6.6-7.8	<2	High	Moderate	Low	0.28		
	15-60	0.6-2.0	0.16-0.21	7.4-8.4	<2	Low	High	Low	0.28		
81*, 82*, 83*:											
Wiley	0-11	0.6-2.0	0.19-0.21	7.4-7.8	<2	Low	High	Low	0.37	5	4L
	11-60	0.6-2.0	0.19-0.21	7.9-8.4	<2	Moderate	High	Low	0.37		
Colby	0-7	0.6-2.0	0.20-0.24	6.6-8.4	<2	Low	Moderate	Low	0.37	5	4L
	7-60	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low	Moderate	Low	0.37		

* See map unit description for the composition and behavior of the map unit.

TABLE 14.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and such terms as "rare," "brief," and "perched." The symbol < means less than; > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			In		
1, 2--- Altvan	B	None	---	---	>6.0	---	---	>60	---	Moderate.
3*:										
Aquolls	D	Frequent	Brief	Apr-Jun	0.5-1.0	Apparent	Apr-Jun	>60	---	High.
Aquents	D	Frequent	Brief	Apr-Jun	0.5-1.0	Apparent	Apr-Jun	>60	---	High.
4*:										
Aquolls	D	Frequent	Brief	Apr-Jun	0.5-1.5	Apparent	Apr-Jun	>60	---	High.
Aquepts	D	Frequent	Brief	Apr-Jun	0.5-1.5	Apparent	Apr-Jun	>60	---	High.
5, 6, 7, 8, 9--- Ascalon	B	None	---	---	>6.0	---	---	>60	---	Moderate.
10--- Bankard	A	Frequent	Brief	Mar-Jun	>6.0	---	---	>60	---	Low.
11, 12--- Bresser	B	None	---	---	>6.0	---	---	>60	---	Moderate.
13--- Cascajo	A	None	---	---	>6.0	---	---	>60	---	Low.
14, 15, 16, 17--- Colby	B	None	---	---	>6.0	---	---	>60	---	Low.
18*:										
Colby	B	None	---	---	>6.0	---	---	>60	---	Low.
Adena	C	None	---	---	>6.0	---	---	>60	---	Low.
19, 20--- Colombo	B	Rare	---	---	>6.0	---	---	>60	---	Moderate.
21, 22--- Dacono	C	None	---	---	>6.0	---	---	>60	---	Low.
23, 24--- Fort Collins	B	None to rare	---	---	>6.0	---	---	>60	---	Low.
25, 26--- Haverson	B	Rare to common.	Brief	May-Sep	>6.0	---	---	>60	---	Low.
27, 28--- Heldt	C	None	---	---	>6.0	---	---	>60	---	Low.
29, 30--- Julesburg	A	None	---	---	>6.0	---	---	>60	---	Moderate.
31, 32, 33, 34--- Kim	B	None	---	---	>6.0	---	---	>60	---	Low.
35*:										
Loup	D	Rare to common.	Brief	Mar-Jun	+.5-1.5	Apparent	Nov-May	>60	---	Moderate.
Boel	A	Occasional	Brief	Mar-Jun	1.5-3.5	Apparent	Nov-May	>60	---	Moderate.
36*:										
Midway	D	None	---	---	>6.0	---	---	10-20	Rippable	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			In		
36*: Shingle	D	None	---	---	>6.0	---	---	10-20	Rippable	Low.
37, 38--- Nelson	B	None	---	---	>6.0	---	---	20-40	Rippable	Low.
39, 40, 41, 42, 43--- Nunn	C	None	---	---	>6.0	---	---	>60	---	Moderate.
44, 45, 46, 47, 48--- Olney	B	None	---	---	>6.0	---	---	>60	---	Low.
49--- Osgood	A	None	---	---	>6.0	---	---	>60	---	Low.
50, 51, 52, 53--- Otero	B	None	---	---	>6.0	---	---	>60	---	Low.
54, 55--- Paoli	B	None to rare	---	---	>6.0	---	---	>60	---	Moderate.
56, 57--- Renohill	C	None	---	---	>6.0	---	---	20-40	Rippable	Low.
58, 59--- Shingle	D	None	---	---	>6.0	---	---	10-20	Rippable	Low.
60*: Shingle	D	None	---	---	>6.0	---	---	10-20	Rippable	Low.
Renohill	C	None	---	---	>6.0	---	---	20-40	Rippable	Low.
61--- Tassel	D	None	---	---	>6.0	---	---	10-20	Rippable	Low.
62, 63--- Terry	B	None	---	---	>6.0	---	---	20-40	Rippable	Low.
64, 65--- Thedalund	C	None	---	---	>6.0	---	---	20-40	Rippable	Low.
66, 67--- Ulm	C	None	---	---	>6.0	---	---	>60	---	Low.
68*--- Ustic Torriorthents	A	None	---	---	>6.0	---	---	>60	---	Low.
69, 70--- Valent	A	None	---	---	>6.0	---	---	>60	---	Low.
71*: Valent	A	None	---	---	>6.0	---	---	>60	---	Low.
Loup	D	Rare to common.	Brief	Mar-Jun	+.5-1.5	Apparent	Nov-May	>60	---	Moderate.
72, 73, 74, 75, 76, 77--- Vona	B	None	---	---	>6.0	---	---	>60	---	Low.

See footnote at end of table.

TABLE 14.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	
					Ft			In		
78, 79, 80---------- Weld	C	None----------	---	---	>6.0	---	---	>60	---	Moderate.
81*, 82*, 83*: Wiley----------	B	None----------	---	---	>6.0	---	---	>60	---	Low.
Colby----------	B	None----------	---	---	>6.0	---	---	>60	---	Low.

* See map unit description for the composition and behavior of the map unit.

TABLE 15.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Adena	Fine-loamy, mixed, mesic Ustollic Paleargids
Altvan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aridic Argiustolls
Aquents	Aquents
Aquepts	Aquepts
Aquolls	Aquolls
Ascalon	Fine-loamy, mixed, mesic Aridic Argiustolls
Bankard	Sandy, mixed, mesic Ustic Torrifluvents
Boel	Sandy, mixed, mesic Fluvaquentic Haplustolls
Bresser	Fine-loamy, mixed, mesic Aridic Argiustolls
Cascajo	Sandy-skeletal, mixed, mesic Ustollic Calciorthids
Colby	Fine-silty, mixed (calcareous), mesic Ustic Torriorthents
Colombo	Fine-loamy, mixed, mesic Torrifluventic Haplustolls
Dacono	Clayey over sandy or sandy-skeletal, montmorillonitic, mesic Aridic Argiustolls
Fort Collins	Fine-loamy, mixed, mesic Ustollic Haplargids
Haverson	Fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Heldt	Fine, montmorillonitic, mesic Ustertic Camborthids
Julesburg	Coarse-loamy, mixed, mesic Aridic Argiustolls
Kim	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Loup	Sandy, mixed, mesic Typic Haplaquolls
Midway	Clayey, montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents
Nelson	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Nunn	Fine, montmorillonitic, mesic Aridic Argiustolls
Olney	Fine-loamy, mixed, mesic Ustollic Haplargids
Osgood	Loamy, mixed, mesic Arenic Ustollic Haplargids
Otero	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Paoli	Coarse-loamy, mixed, mesic Pachic Haplustolls
Renohill	Fine, montmorillonitic, mesic Ustollic Haplargids
Shingle	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Tassel	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Terry	Coarse-loamy, mixed, mesic Ustollic Haplargids
Thedalund	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Ulm	Fine, montmorillonitic, mesic Ustollic Haplargids
Ustic Torriorthents	Ustic Torriorthents
Valent	Mixed, mesic Ustic Torripsamments
Vona	Coarse-loamy, mixed, mesic Ustollic Haplargids
Weld	Fine, montmorillonitic, mesic Aridic Paleustolls
Wiley	Fine-silty, mixed, mesic Ustollic Haplargids

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Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

MAP UNITS

- **1** Midway-Shingle: Shallow, moderately sloping to strongly sloping, well drained clays and loams formed in residuum from calcareous shale
- **2** Ulm-Nunn: Deep, level to gently sloping, well drained clay loams and loams formed in alluvial and eolian deposits
- **3** Weld-Colby: Deep, nearly level to moderately sloping, well drained loams formed in calcareous eolian deposits
- **4** Wiley-Colby-Weld: Deep, nearly level to moderately sloping, well drained silt loams and loams formed in calcareous eolian deposits
- **5** Olney-Kim-Otero: Deep, nearly level to moderately sloping, well drained sandy loams and loams formed in mixed alluvium and eolian deposits
- **6** Otero-Thedalund-Nelson: Deep and moderately deep, nearly level to moderately sloping, well drained sandy loams and clay loams formed in alluvium and eolian deposits and in residuum from shale and sandstone
- **7** Tassel-Thedalund-Terry: Shallow to moderately deep, gently sloping to strongly sloping, well drained sandy loams to clay loams formed in residuum from sandstone and shale
- **8** Valent-Vona-Osgood: Deep, nearly level to moderately sloping, well drained to excessively drained sands and sandy loams formed in eolian deposits
- **9** Aquolls-Aquents-Bankard: Deep, level and nearly level, poorly drained and somewhat excessively drained loamy soils and sandy loams formed in alluvium
- **10** Loup-Boel: Deep, level and nearly level, somewhat poorly drained and poorly drained loamy sands formed in sandy alluvium
- **11** Nunn-Haverson: Deep, level and nearly level, well drained loams and clay loams formed in alluvium
- **12** Nunn-Dacono-Altvan: Deep, level and nearly level, well drained loams and clay loams formed in alluvium
- **13** Julesburg-Bresser: Deep, level and nearly level, well drained sandy loams formed in alluvium

*The terms for texture used in the descriptive heading apply to the surface layer of the major soils.

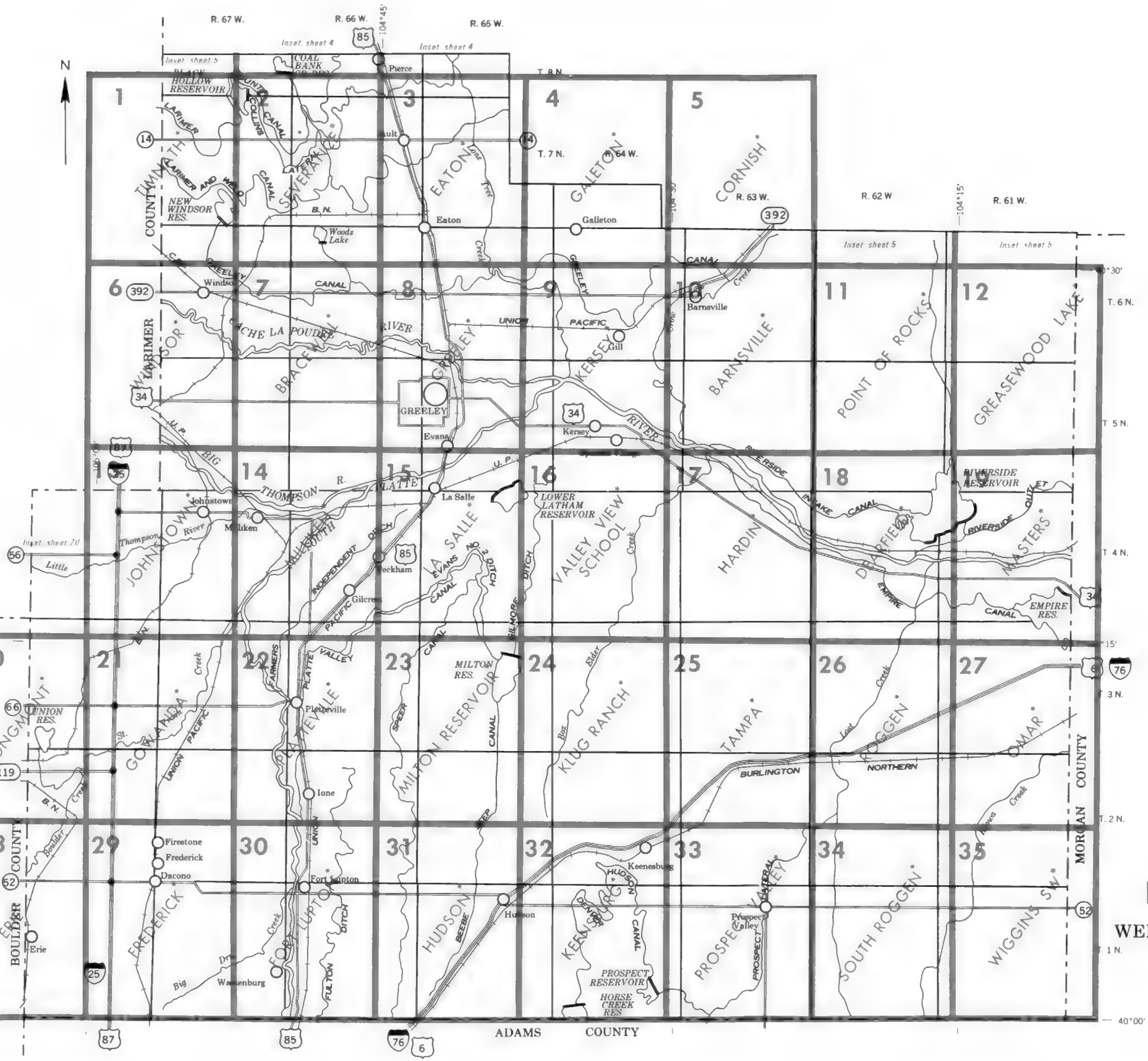
Compiled 1979

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
COLORADO AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

WELD COUNTY, COLORADO, SOUTHERN PART

Scale 1:316,800
1 0 1 2 3 4 5 Miles



*QUADRANGLE NAME

INDEX TO MAP SHEETS

WELD COUNTY, COLORADO, SOUTHERN PART

Scale 1: 316,800

1 0 1 2 3 4 5 Miles

SOIL LEGEND

SYMBOL	NAME
1	Altvan loam, 0 to 1 percent slopes
2	Altvan loam, 1 to 3 percent slopes
3	Aquolls and Aquents, gravelly substratum
4	Aquolls and Aquepts, flooded
5	Ascalon sandy loam, 1 to 3 percent slopes
6	Ascalon sandy loam, 3 to 5 percent slopes
7	Ascalon sandy loam, 5 to 9 percent slopes
8	Ascalon loam, 0 to 1 percent slopes
9	Ascalon loam, 1 to 3 percent slopes
10	Bankard sandy loam, 0 to 3 percent slopes
11	Bresser sandy loam, 0 to 1 percent slopes
12	Bresser sandy loam, 1 to 3 percent slopes
13	Cascajo gravelly sandy loam, 5 to 20 percent slopes
14	Colby loam, 0 to 1 percent slopes
15	Colby loam, 1 to 3 percent slopes
16	Colby loam, 3 to 5 percent slopes
17	Colby loam, 5 to 9 percent slopes
18	Colby-Adena loams, 3 to 9 percent slopes
19	Colombo clay loam, 0 to 1 percent slopes
20	Colombo clay loam, 1 to 3 percent slopes
21	Dacono clay loam, 0 to 1 percent slopes
22	Dacono clay loam, 1 to 3 percent slopes
23	Fort Collins loam, 0 to 1 percent slopes
24	Fort Collins loam, 1 to 3 percent slopes
25	Haverson loam, 0 to 1 percent slopes
26	Haverson loam, 1 to 3 percent slopes
27	Heldt silty clay, 1 to 3 percent slopes
28	Heldt silty clay, 3 to 5 percent slopes
29	Julesburg sandy loam, 0 to 1 percent slopes
30	Julesburg sandy loam, 1 to 3 percent slopes
31	Kim loam, 0 to 1 percent slopes
32	Kim loam, 1 to 3 percent slopes
33	Kim loam, 3 to 5 percent slopes
34	Kim loam, 5 to 9 percent slopes
35	Loup Boel loamy sands, 0 to 3 percent slopes
36	Midway Shingle complex, 5 to 20 percent slopes
37	Nelson fine sandy loam, 0 to 3 percent slopes
38	Nelson fine sandy loam, 3 to 9 percent slopes
39	Nunn loam, 0 to 1 percent slopes
40	Nunn loam, 1 to 3 percent slopes
41	Nunn clay loam, 0 to 1 percent slopes
42	Nunn clay loam, 1 to 3 percent slopes
43	Nunn loamy sandy, 0 to 1 percent slopes
44	Olney loamy sand, 1 to 3 percent slopes
45	Olney loamy sand, 3 to 5 percent slopes
46	Olney fine sandy loam, 0 to 1 percent slopes
47	Olney fine sandy loam, 1 to 3 percent slopes
48	Olney fine sandy loam, 3 to 5 percent slopes
49	Osgood sand, 0 to 3 percent slopes
50	Otero sandy loam, 0 to 1 percent slopes
51	Otero sandy loam, 1 to 3 percent slopes
52	Otero sandy loam, 3 to 5 percent slopes
53	Otero sandy loam, 5 to 9 percent slopes
54	Paoli loam, 0 to 1 percent slopes
55	Paoli loam, 1 to 3 percent slopes
56	Renohill clay loam, 0 to 3 percent slopes
57	Renohill clay loam, 3 to 9 percent slopes
58	Shingle loam, 1 to 3 percent slopes
59	Shingle loam, 3 to 9 percent slopes
60	Shingle Renohill complex, 3 to 9 percent slopes
61	Tassel fine sandy loam, 5 to 20 percent slopes
62	Terry fine sandy loam, 0 to 3 percent slopes
63	Terry fine sandy loam, 3 to 9 percent slopes
64	Thedalund loam, 1 to 3 percent slopes
65	Thedalund loam, 3 to 9 percent slopes
66	Ulm clay loam, 0 to 3 percent slopes
67	Ulm clay loam, 3 to 5 percent slopes
68	Ustic Torriorthents, moderately steep
69	Valent sand, 0 to 3 percent slopes
70	Valent sand, 3 to 9 percent slopes
71	Valent Loup complex, 0 to 9 percent slopes
72	Vona loamy sand, 0 to 3 percent slopes
73	Vona loamy sand, 3 to 5 percent slopes
74	Vona loamy sand, 5 to 9 percent slopes
75	Vona sandy loam, 0 to 1 percent slopes
76	Vona sandy loam, 1 to 3 percent slopes
77	Vona sandy loam, 3 to 5 percent slopes
78	Weld loam, 0 to 1 percent slopes
79	Weld loam, 1 to 3 percent slopes
80	Weld loam, 3 to 5 percent slopes
81	Wiley Colby complex, 0 to 1 percent slopes
82	Wiley Colby complex, 1 to 3 percent slopes
83	Wiley Colby complex, 3 to 5 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (70)
- Federal (419)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; W)

PITS

- Gravel pit (G.P)
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; W)
- Intermittent (int; I)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (SvE 107)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown) (S)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 1
WELD COUNTY, COLORADO, SOUTHERN PART
(TIMNATH QUADRANGLE)

R. 68 W. | R. 67 W.

T. 7 N. | T. 8 N.

T. 7 N | T. 8 N.

(Joins inset A, sheet 5)

BLACK HOLLOW RESERVOIR

LARIMER COUNTY CANAL

CACTUS HILL LATERAL

LATERAL

PIERCE

LARIMER COUNTY CANAL

LARIMER COUNTY CANAL

SOUTHERN COLORADO IND.

MAHOOD RESERVOIR

JAMES LAKE

Black Hollow

LARIMER COUNTY

LARIMER COUNTY IND.

SMITH RESERVOIR

WELD CANAL

EATON CANAL

LAKE CANAL

WINDSOR RESERVOIR

THOMPSON LAKE

LAKE CANAL RESERVOIR NO. 1

(Joins sheet 2)

(Joins sheet 6)

T. 6 N. | T. 7 N.

T. 6 N. | T. 7 N.

R. 68 W. | R. 67 W.

105°00'

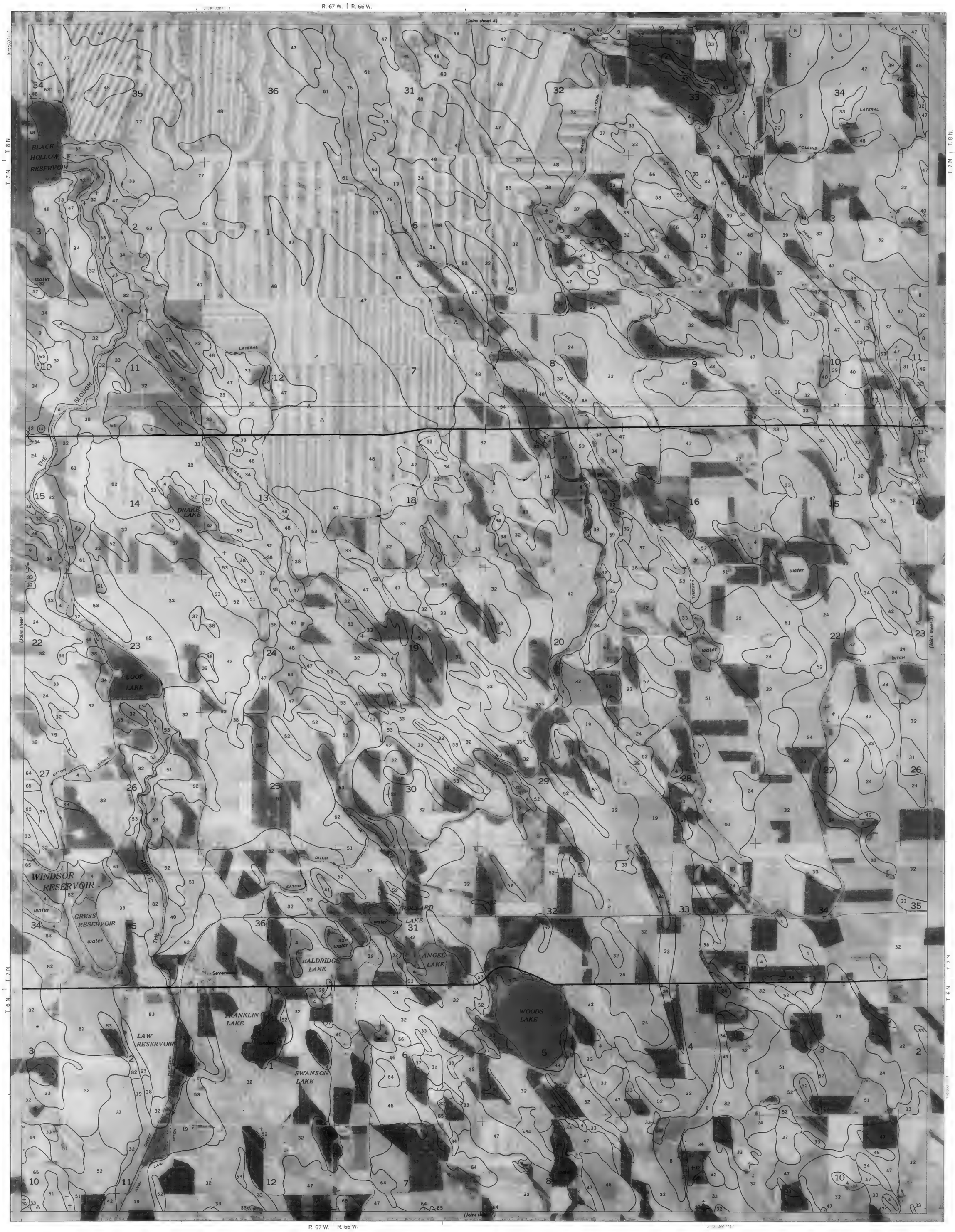
40°30'

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



104°52'30"

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

104°45'

40°30'

R. 66 W. | R. 65 W.

T. 7 N. | T. 8 N.

T. 6 N. | T. 7 N.

(Joins inset B, sheet 4)

(Joins sheet 2)

(Joins sheet 4)

(Joins inset B)

UNION PACIFIC

COLLINS LATERAL

EATON DITCH

Lone Tree Creek

Spring water Creek

Oul Creek

CLARK LAKE

COZZENS LAKE

SAXTON LAKE water

LIMIT OF SOIL SURVEY

Eaton

GREAT WESTERN

Eaton Draw

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1 ⅜ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 4
WELD COUNTY, COLORADO, SOUTHERN PART
(GALETON QUADRANGLE)

INSET A

INSET B

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

WELD COUNTY COLORADO SOUTHERN PART NO 4

INSET B

INSET C

INSET A

(Joins sheet 11)
(Joins sheet C, sheet 5)
(Joins sheet B, sheet 5)
(Joins sheet 10)
(Joins sheet 4)
(Joins inset A, sheet 4)
(Joins inset B, sheet 5)

LIMIT OF SOIL SURVEY

R. 62 W.
R. 61 W.
R. 64 W.
R. 63 W.
R. 67 W.

T 6 N.
T 7 N.
T. 8 N.

MORGAN COUNTY

GREASEWOOD FLATS

Crow Creek

intermittent

104°15'
104°22'30"
104°30'
104°37'30"
104°45'
104°52'30"
40°31'45"
40°38'30"
40°45'
40°33'

3000 AND 10000 FOOT GRID TICKS

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1 ¼ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

2 140 000 FEET

R. 67 W.

104°52'30"

40°30'

(Joins sheet 1)

T.5N | T.6N.

T.5N | T.6N

COUNTY

LARIMER

WINDSOR LAKE

OKLAHOMA RESERVOIR

KOENIG RESERVOIR

CACHE LA POUDRE RIVER

BIG THOMPSON RIVER

COLORADO

GREELEY

NO. 2 CANAL

WESTERN CANAL

SOUTHERN GREAT WESTERN DITCH

LONGMONT AND GREELEY CANAL

GREAT WESTERN AND BRUSH HILL DITCH

EATON DITCH

Windsor

Lory

Goya

Keenig

(Joins sheet 13)

104°22'30"

105°00'

2 140 000 FEET

R. 67 W.

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1 ⅔ ½ ⅓ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 7
WELD COUNTY, COLORADO, SOUTHERN PART
(BRACEWELL QUADRANGLE)

R. 67 W. | R. 66 W.

T. 5 N. | T. 6 N.

T 5 N | 1 6 N

(Joins sheet)

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 14)

ANTELOPE HILL

POULAND DITCH

LATERAL

EASTERN DITCH

LAKE

GREELEY NO. 2 CANAL

NEPF LAKE

BOGARTY RESERVOIR

NEIMAN LAKE

COLORADO AND SOUTHERN

CACHE LA POUDRE RIVER

Draw

BOOMERANG DITCH

NORTH BOOMERANG

Sheep Draw

GRAPEVINE DITCH

WELAND AND GREELEY CANAL

40°30'

40°22'30"

104°52'30"

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

1 ⅜ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

WELD COUNTY, COLORADO, SOUTHERN PART NO. 7

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 8
WELD COUNTY, COLORADO, SOUTHERN PART
(GREELEL QUADRANGLE)

R. 66 W. | R. 65 W.

T. 5 N | T. 6 N.

T 5 N | T 6 N

R. 66 W. | R. 65 W.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

WELD COUNTY, COLORADO, SOUTHERN PART NO. 8

104°40'

R. 65 W. | R. 64 W.

(Joins sheet 4)

4 570 000 FEET

T. 5 N. | T. 6 N.

(Joins sheet 8)

HOWARDS LAKE

FOX RESERVOIR

LINDISS LAKE

BRISCOE LAKE

Lone Tree Creek

Tree Creek

Crow Creek

Crow Creek

GREELEY NO. 2 DITCH

GREELEY NO. 2 DITCH

PACIFIC DITCH

UNION PACIFIC

Clovelly

Alden

Gill

Kersey

OGILVY DITCH

OGILVY DITCH

NORTH FORK SOUTH FORK

PLUMB DITCH

LATHAM DITCH

CACHE LA POUDRE RIVER

SOUTH PLATTE RIVER

(Joins sheet 10)

T 5 N. | T 6 N.

40°22'30"

(Joins sheet 16)

R. 65 W. | R. 64 W.

12 270 000 FEET

104°37'30"

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

R. 64 W. | R. 63 W.

40°30'

T 5 N. | T 6 N.

(Joins sheet 5)

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 17)

Barnsville

Crow Creek

Creek

water

LATERAL

SIDE

NORTH

RIVERSIDE INLET CANAL

UNION PACIFIC

40°22'30"

2 310 000 FEET

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

1 0 1 2 Miles

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

104°15'

R. 62 W. | R. 61 W.

2 320 000 FEET

(Joins inset 8, sheet 5)

40°30'

POINT OF ROCKS

Sanborn Draw

T. 5 N. | T. 6 N.

(Joins sheet 10)

(Joins sheet 12)

2 340 000 FEET

40°22'30"

104°22'30"

R. 62 W. | R. 61 W.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ½ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

R. 61 W.

(Joins inset, C Joins sheet 5)

GREASEWOOD LAKE

GREASEWOOD FLATS

intermittent

MORGAN COUNTY

T. 5 N. I T. 6 N.

(Joins sheet 11)

Sanborn Draw

(Joins sheet 19)

R. 61 W.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

2 140 000 FEET — R. 68 W. | R. 67 W. — 105°00'

T 4 N | T 5 N — T 3 N | T 4 N — 40°15'

105°00' — R. 68 W. | R. 67 W.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

R. 67 W. | R. 66 W.

T. 4 N. | T. 5 N.

T. 3 N. | T. 4 N.

(Joins sheet 7)

(Joins sheet 14)

(Joins sheet 15)

(Joins sheet 22)

Milliken

Peckham

Gilcrest

Houston

THOMPSON RIVER

BIG THOMPSON

LITTLE THOMPSON DITCH

THOMPSON AND PLATTE DITCH

LOVELAND CANAL

SOUTH PLATTE RIVER

WILDCAT MOUND

FARMERS INDEPENDENT DITCH

UNION PACIFIC

GREAT WESTERN

This map is compiled on 1974 aerial photography by the U S Department of Agriculture Soil Conservation Service and cooperating agencies

1 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

1 ⅜ ½ ⅛ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 16
WELD COUNTY, COLORADO, SOUTHERN PART
(VALLEY VIEW SCHOOL QUADRANGLE)

2 250 000 FEET R. 65 W. | R. 64 W.

(Joins sheet 9)

T. 4 N. | T. 5 N.

(Joins sheet 15)

(Joins sheet 17)

T. 3 N. | T. 4 N.

(Joins sheet 24)

2 270 000 FEET

104°37'30"

40°15'

340 000 FEET

R. 65 W. | R. 64 W.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ⅞ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

WELD COUNTY, COLORADO, SOUTHERN PART NO. 16

R. 64 W. | R. 63 W.

40°22'30"

T. 4 N. | T. 5 N.

T. 4 N. | T. 5 N.

(Joins sheet 10)

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 25)

T. 3 N. | T. 4 N.

T. 3 N. | T. 4 N.

40°15'

R. 64 W. | R. 63 W.

104°30'

2 310 000 FEET

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 18
WELD COUNTY, COLORADO, SOUTHERN PART
(DEARFIELD QUADRANGLE)

R. 63 W. | R. 62 W.

R. 62 W. | R. 61 W

(Joins sheet 11)

T. 4 N. | T. 5 N.

T. 4 N. | T. 5 N.

(Joins sheet 17)

(Joins sheet 19)

T. 3 N. | T. 4 N.

T. 3 N. | T. 4 N.

(Joins sheet 26)

RIVERSIDE RESERVOIR

SOUTH PLATTE RIVER

UNION PACIFIC

RIVERSIDE INLET CANAL

EMPIRE INLET CANAL

BIJOU CANAL

Lost Creek

Dearfield

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

R. 61 W.

(Joins sheet 12)

T. 4 N. | T. 5 N.

RIVERSIDE RESERVOIR

RIVERSIDE INLET CANAL

JACKSON LAKE INLET

PACIFIC UNION SOUTH PLATTE RIVER

EMPIRE INLET CANAL

EMPIRE RESERVOIR

BIJOU CANAL

MORGAN COUNTY

(Joins sheet 18)

(Joins sheet 27)

T. 3 N. | T. 4 N.

R. 61 W.

This map was compiled on 1974 aerial photography by the U.S. Department of Agriculture Soil Conservation Service and cooperating agencies

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

105°00'
40°21'30"
R. 68 W.
2 125 000 FEET
370 000 FEET
LARIMER COUNTY
TWIN MOUNDS
HIGHLAND LAKE
MEAD RESERVOIRS
Mead
DITCH
SUPPLY
HIGHLAND
GREAT WESTERN
HANDY
HUMMEL RESERVOIR
NEWELL LAKE
CALKINS LAKE
SANBORN RESERVOIR
(Joins inset, sheet 20)
(Joins sheet 13)
(Joins sheet 21)
RIVER
LITTLE
THOMPSONS HOLLOW
BAXTER LAKE
BIG
THOMAS RESERVOIR
NEW ISH DITCH
LATERAL
BOULDER COUNTY
CREEK
ST. VRAIN
Creek
BURLINGTON
NORTHERN
Boulder
Jessum
Idaho
(Joins sheet 28)
T 3 N
T 4 N.
T.2 N.
T 3 N.
water
2 135 000 FEET
2 140 000 FEET
345 000 FEET
40°15'
40°07'30"
105°03'30"
5000 AND 10000-FOOT GRID TICKS
R. 68 W.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

Scale 1:24 000
2 Miles
5 000 Feet
10 000 Feet

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

R. 68 W. | R. 67 W.

(Joins sheet 13)

T. 2 N. | T. 3 N.

(Joins sheet 20)

(Joins sheet 21)

R. 68 W. | R. 67 W.

105°00'

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

R. 67 W. | R. 66 W.

(Joins sheet 14)

EAST ST. VRAIN POWER PLANT

Platteville

WHEELER LAKE

Vollmar

MOSE DAVIS LAKE

MIZPAH CEMETERY

(Joins sheet 21)

(Joins sheet 23)

(Joins sheet 30)

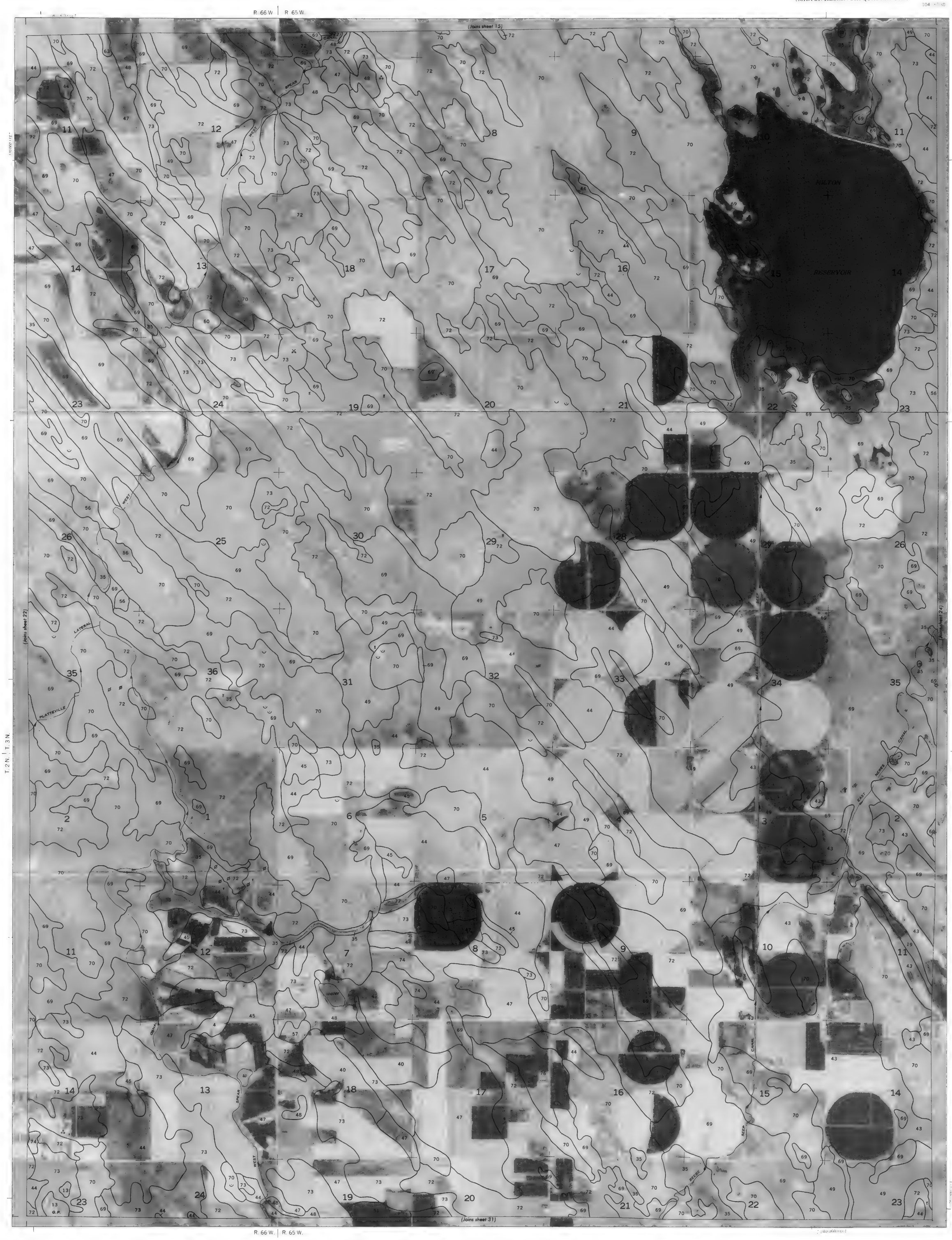
T. 2 N. | T. 3 N.

R. 67 W. | R. 66 W.

This map is compiled on 1974 aerial photography by the U S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system Land division corners, if shown, are approximately positioned



This map is compiled on 1974 aerial photography by the U S. Department of Agriculture, Soil Conservation Service and cooperating agencies

Scale 1:24 000

10,000-foot grid ticks based on state coord nate system. Land division corners, if shown, are approximately pos tioned

R. 65 W. | R. 64 W.

104°30'

2 250 000 FEET

40°15'

(Joins sheet 16)

(Joins sheet 23)

(Joins sheet 25)

T. 2 N. | T. 3 N.

KLUG LAKE

Elder Creek

Box Elder Creek

CANAL

HERES

EAST

2 250 000 FEET

40°07'30"

104°37'30"

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 | ⅘ | ½ | ¼ | 0 | 1 | 2 Miles

5 000 | 4 000 | 3 000 | 2 000 | 1 000 | 0 | 5 000 Feet | 10 000 Feet

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

R. 64 W. | R. 63 W.

(Joins sheet 17)

(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 33)

T. 2 N. | T. 3 N.

T. 2 N. | T. 3 N.

Lost Creek

BURLINGTON NORTHERN

R. 64 W. | R. 63 W.

R. 63 W. | R. 62 W.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 26
WELD COUNTY, COLORADO, SOUTHERN PART
(ROGGEN QUADRANGLE)

104 15

R 62 W | R 61 W

40 07 30

(Joins sheet 18)

MONAHAN LAKES

Lost Creek

Sand Creek

Long Draw

Reggin

BURLINGTON NORTHERN

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 34)

T. 2 N | T. 3 N.

2 340 000 FEET

R. 62 W. R. 61 W.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

R. 61 W.

EMPIRE RESERVOIR

NORTHERN

BURLINGTON

Creek

Kiowa

Rabbit

Jack

MORGAN COUNTY

T. 3 N.

T. 2 N.

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 28
WELD COUNTY, COLORADO, SOUTHERN PART
(ERIE QUADRANGLE)

105°00'

2 110 000 FEET

R. 68 W.

40°07'30"

(Joins sheet 20)

T. 1 N. | T. 2 N.

BOULDER COUNTY

ADAMS COUNTY

(Joins sheet 29)

40°00'

105°07'30"

R. 68 W. 2 130 000 FEET

This map is compiled on 1974 aerial photography by the U S Department of Agriculture, Soil Conservation Service and cooperating agencies

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 29
WELD COUNTY, COLORADO, SOUTHERN PART
(FREDERICK QUADRANGLE)

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

WELD COUNTY, COLORADO, SOUTHERN PART NO. 29

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 30
WELD COUNTY, COLORADO, SOUTHERN PART
(FORT LUPTON QUADRANGLE)

R. 67 W. | R. 66 W.

(Joins sheet 22)

T. 1 N. | T. 2 N.

(Joins sheet 29)

(Joins sheet 31)

ADAMS COUNTY

Wattenberg

Powars

FORT LUPTON

SMITH MOUND

HILLSIDE CEMETERY

PLATTEVILLE

PLATTE RIVER SOUTH

Dry Creek

Little Dry Creek

Big Dry Creek

BRANTNER DITCH

BRIGHTON LATERAL DITCH

FULTON DITCH

LUPTON BOTTOM DITCH

PACIFIC UNION DITCH

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

1 0 1 2 Miles

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

WELD COUNTY, COLORADO, SOUTHERN PART NO. 30

104°37'30"

40°07'30"

R 66 W | R 65 W

(Joins sheet 23)

RILEY MOUND

CARLIN RESERVOIR

THE SAND HILLS

CANAL

SEEP

SPEAR

BEEBE

NORTHERN

MOUNTAIN VIEW CEMETERY

Hudson

TRIANGLE RESERVOIR NO. 1

SEQUINE RESERVOIR

STYBR RESERVOIR NO. 2

HENRY LAKE RESERVOIR

Tonville

DITCH

EXTENSION

WRIGHT

BOWLES

BURLINGTON

DENVER

HUDSON

BOX ELDER

LATERAL

T. 1 N. | T. 2 N.

(Joins sheet 30)

(Joins sheet 32)

ADAMS COUNTY

40°00'

R. 66 W. | R. 65 W.

104°45'

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies

1 3/8 1/2 1/4 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned

2 250 000 FEET | R. 65 W. | R. 64 W. | 104°30'

40°07'30"

T. 1 N. | T. 2 N.

2 280 000 FEET

(Joins sheet 24)

(Joins sheet 31)

(Joins sheet 33)

Keenesburg

DE REMER LAKES

RESERVOIR NO. FIVE

IRELAND RESERVOIR NO. FOUR

IRELAND RESERVOIR NO. ONE

BANNER LAKES

HORSE CREEK RESERVOIR

PROSPECT RESERVOIR

Jim Creek

Box Elder Creek

Horse Creek

Hudson Canal

Denver Canal

Low Line Canal

Prospect Lateral

Keen Lateral

Northern Lateral

Burlington Lateral

Highline Canal

ADAMS COUNTY

40°00'

R. 65 W. | R. 64 W.

104°37'30"

2 280 000 FEET

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet
Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 33
WELD COUNTY, COLORADO, SOUTHERN PART
(PROSPECT VALLEY QUADRANGLE)

104°22'30"

R. 64 W. | R. 63 W. | R. 63 W. | R. 62 W.

2 290 000 FEET

40°07'30"

280 000 FEET

T. 1 N. | T. 2 N.

LORD RESERVOIR

Prospect Valley

(Joins sheet 25)

(Joins sheet 32)

(Joins sheet 34)

ADAMS COUNTY

2 310 000 FEET

250 000 FEET

40°00'

104°30'

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 Scale 1:24 000 5 000 Feet 10 000 Feet

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

WELD COUNTY, COLORADO, SOUTHERN PART NO. 33

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET NO. 34
WELD COUNTY, COLORADO, SOUTHERN PART
(SOUTH ROGGEN QUADRANGLE)

104°15'

2 320 000 FEET

R. 62 W. | R. 61 W.

40°07'30"

250 000 FEET

T. 1 N. | T. 2 N.

(Joins sheet 26)

(Joins sheet 33)

(Joins sheet 35)

South Roggen

Draw

Draw

Draw

Draw

Creek

Creek

Creek

Creek

Kiowa

Kiowa

Kiowa

Comanche

int

int

ADAMS COUNTY

40°00'

2 340 000 FEET

R. 62 W. | R. 61 W.

104°22'30"

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.

2 350 000 FEET

R. 61 W.

104°07'30"

40°07'30"

(Joins sheet 27)

T. 1 N. | T. 2 N.

Rabbit Creek

Jack Creek

Kiowa Creek

Coose Creek

Kiowa Creek

water

MORGAN COUNTY

(Joins sheet 34)

Mule Creek

ADAMS COUNTY

40°00'

R. 61 W.

2 380 000 FEET

2 350 000 FEET

104°15'

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.

1 ¾ ½ ¼ 0 1 2 Miles

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet 10 000 Feet

Scale 1:24 000

10,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.